

THE HEGAR CACHE (41HR1030)

A Dissertation

by

VICTOR JOSEPH GALAN, JR.

Submitted to the Office of Graduate Studies of  
Texas A&M University  
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2007

Major Subject: Anthropology

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Approved by:

Committee Chair,  
Committee Members,

Head of Department,

Michael R. Waters  
Harry J Shafer  
David L. Carlson  
Edward C.A. Runge  
Donny Hamilton

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## ABSTRACT

The Hegar Cache (41HR1030). (December 2007)

Victor Joseph Galan, Jr., B.A., Stephen F. Austin State University;

M.A., University of Arkansas

Chair of Advisory Committee: Dr. Michael R. Waters

A lithic cache is described as a cluster of several items that can be worked into a variety of tools or a collection of tools typical of a particular task. The behavior associated with caching includes subsistence, survival, trade, or ceremonial/ritual needs of the individual or group. Caches are typically found either in association with larger archaeological sites and can be interpreted in context with the other features and artifacts or they are found isolated from any known archaeological sites. Isolated caches, therefore, represent a unique set of conditions that require careful examination of the excavation data to understand the site formation processes and careful examination of the artifacts to attempt to place the cache in a temporal and spatial context and understand the behavior associated with placing the cache in that location. The discovery of 26 Angostura-like bifaces in northwest Harris County, Texas provides a unique opportunity to examine isolated caching behavior in a portion of Texas with few documented cache sites. Excavation of the site and analysis of the bifaces suggest the cached material is the result of trade and may be associated with ceremonial or ritualistic practices along the gulf coast.

## DEDICATION

This dissertation is dedicated to Dr. Jim Corbin, Professor Emeritus (Posthumously) of Stephen F. Austin State University. Not only is he one of three men I admire most, but without his belief in my ability to complete this degree, I would have never started.



## ACKNOWLEDGEMENTS

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A final and deepest thanks to my wife, Rachel, who not only provided a sounding board during all hours of the day, but endured six years of my frequent overnight absences for classes, lost weekends while excavating, and the associated stress of essentially being a single parent of three children while I was taking time to research and write.

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## CHAPTER I

### INTRODUCTION

Caches are poorly understood archaeological phenomena. Archaeological information reveals that a lithic cache is a cluster of several items of an “early” form (e.g., blanks, blades, raw material cobbles) that can be reworked into a variety of items (Green 1963:150; Tunnel 1978) or an assemblage of items typical of a task (Walthall and Holley 1997) closely arranged in a small pit feature. Other researchers examining caching behavior also include the potential uses as burial offerings, trade goods, or other ceremonial uses (Miller 1993:1). Lithic cache content can range in size from a few to several hundred items (Greiser 1985:303) and have been found in both isolated context or part of larger prehistoric habitations. The behavior that produced the cache varies widely including practical subsistence, survival, trade, or ceremonial/ritual needs. This dissertation will describe an isolated lithic biface cache of 26 Angostura-like bifaces in northwest Harris County Texas, examine caching behavior, and compare the Hegar cache to expected archaeological context predicted by the various behavior models. The Introduction defines caches archaeologically, provides information on the site setting, and describes the cache discovery. The second chapter, Excavation, describes the depositional environment of the sediments and soil formation as well as describes the excavations, samples, and spatial distribution of the cultural material. The third chapter, Biface Analysis, describes the bifaces recovered from the site focusing

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This dissertation follows the style of *American Antiquity*.

on understanding the stage of reduction, attempts to place the bifaces within a defined typology, and examines the bifaces for microscopic use wear. The fourth chapter, Caching Behavior, describes several cognitive functions associated with caching behavior. These generally include storage of material and items for either a predicted need or an unexpected situation but can include trade and ceremonial caching. The final chapter, Conclusions, applies the information from the excavations, the biface analysis, and behavioral models to place the Hegar cache in temporal, spatial, and cultural context.

#### Cache Definition

Archaeologists attempting to define caches often impose a purpose for the cache by relying on Binford's Logistic Mobility and Optimal Foraging Theory (e.g., Amick 1996; Bamforth 1986). Following these theories and Binford's ethnographic work with the Nunamiut (Binford 1979), some archaeologists have defined caching as storing items with the intention of retrieving them as needed (Kay 1985:83 in Kornfeld et al. 1990: Walthall and Holley 1997; Schlanger 1981:4) that is typical of foraging societies (Kornfeld et al. 1990). Cached materials or items are obtained within normal group movement patterns then are modified, utilized, and recycled as needed (Kornfeld et al. 1990:307). This model and definition exclude burial goods or other votives which imply the items will not be recovered (Collins 1999; Kornfeld *et. al.* 1990:301; Miller 1993:7; Schlanger 1981:4; and Tunnell 1978).

Burials often include implements, ornaments, and exotic artifacts (Bement 1991; Taylor and Highley 1993) with items arranged around a body, and are not removed once the burial is filled. Within the archaeological record there is little to distinguish caches from burials since both organic cached material and human remains may degrade over time leaving only stone artifacts; however, data derived from Paleoindian burials (e.g., Horn Rock Shelter No.2 and Wilson-Leonard) and Archaic cemeteries (e.g., Ernest Witte) in Texas suggest interred individuals are surrounded by a wide range of exotic items (Ricklis 2004:185) and the locations can be used as visual markers to members of the group or adjacent groups (Aten 1984:85). Site furniture is another term often confused with caching. Both Allchin (1957:117) and Binford (1979:264) describe site furniture as items that were associated with the location and used by anyone who visited the site, for example, nutting stones. Following these definitions, caches differ in that a limited number of individuals know where the cache is located and what it contains. Caches are hidden while burials (during the Archaic and in the region) and site furniture are meant to be seen and used by a wide audience.

Distinguishing hidden versus public often relies on location. Cache locations range from features on larger archaeological sites (Kornfeld *et. al.* 1990) to “isolated” caches further from known sites (Button 1989:216). Peripheral observations while researching cache descriptions revealed that caches on sites are on topographically distinct features while isolated caches were on minor topographic features that were not used for habitation. Miller (1993:22) makes this same observation, but he does not add any geographical or statistical analysis for support. Many of the caches were found on



small hills, knolls, or ridge crests overlooking named creeks within 10 kilometers (6 miles) of major rivers. Further investigation found that areas around isolated caches were not systematically investigated for other archaeological sites; however, most isolated caches were found on minor landforms adjacent to larger, more prominent landforms conducive to containing archaeological sites.

In summary, a cache includes items typically closely arranged in a small pit feature. The difference between a cache and a burial would be the number, arrangement, and the type of items found in an archaeological context and the proximity of the buried items to other features if found on an archaeological site, or the relationship between the cache and the landform if found in an isolated context. Caches include hidden items with a limited distribution of knowledge (often associated with a house or minor landform) while a burial, votive offering, or site furniture includes a variety of items and, along the coastal region of Texas, is intended to act as a marker or location for broader use in or between groups (Aten 1984:82).

Specific to this study, a lithic cache, as often described as a cluster of several items of a “early” form (e.g., blanks, blades, raw material cobbles) that can be reworked into a variety of items (similar to the descriptions provided in Green 1963:150 and Tunnel 1978), or an assemblage of items typical of a task (similar to the Lembke cache described by Walthall and Holley 1997). These items are typically closely arranged in a small pit feature. No purpose of the lithic cache is assumed in this description; however, the association with other features, stages of reduction, number of items, or diversity of

items should provide evidence to distinguish if the items will be recovered and utilized for provisioning a place for future need, banking/insurance, trade, or ritualistic purposes.

### Discovery of the Hegar Cache

The Hegar Cache is a collection of 26 Angostura-like bifaces in northwest Harris County Texas in a hay pasture south of Spring Creek roughly 40 kilometers (25 miles) northwest elevation in the county and near the water shed boundary of the Brazos River drainage system to the south and the San Jacinto River drainage system to the north (Figure 1). The landowners, Larry and Juda Hegar, frequently excavated clay and gravel for fill material with a box blade from this location because the clay was so close to the surface. On the day of the discovery, Mr. Hegar was in the process of repairing a recently eroded barn floor. The bifaces were visible on the exposed clay/gravel surface exposed by the recent rain. Although Mr. Hegar had collected a “large spear point” in an earlier visit, the discovery of 16 in one area promoted Mrs. Hegar to call advocational archaeologist Sharon Menendez. Photos of the location were made (Figure 2) and the bifaces were collected to protect them from cattle. Mrs. Menendez then contacted the Texas A&M Anthropology Department. The discovery of this cache and the willingness of the Hegars to stop excavating once the cache was discovered is a unique opportunity to investigate a cache site with the potential of finding intact features in the undisturbed portion of the site.

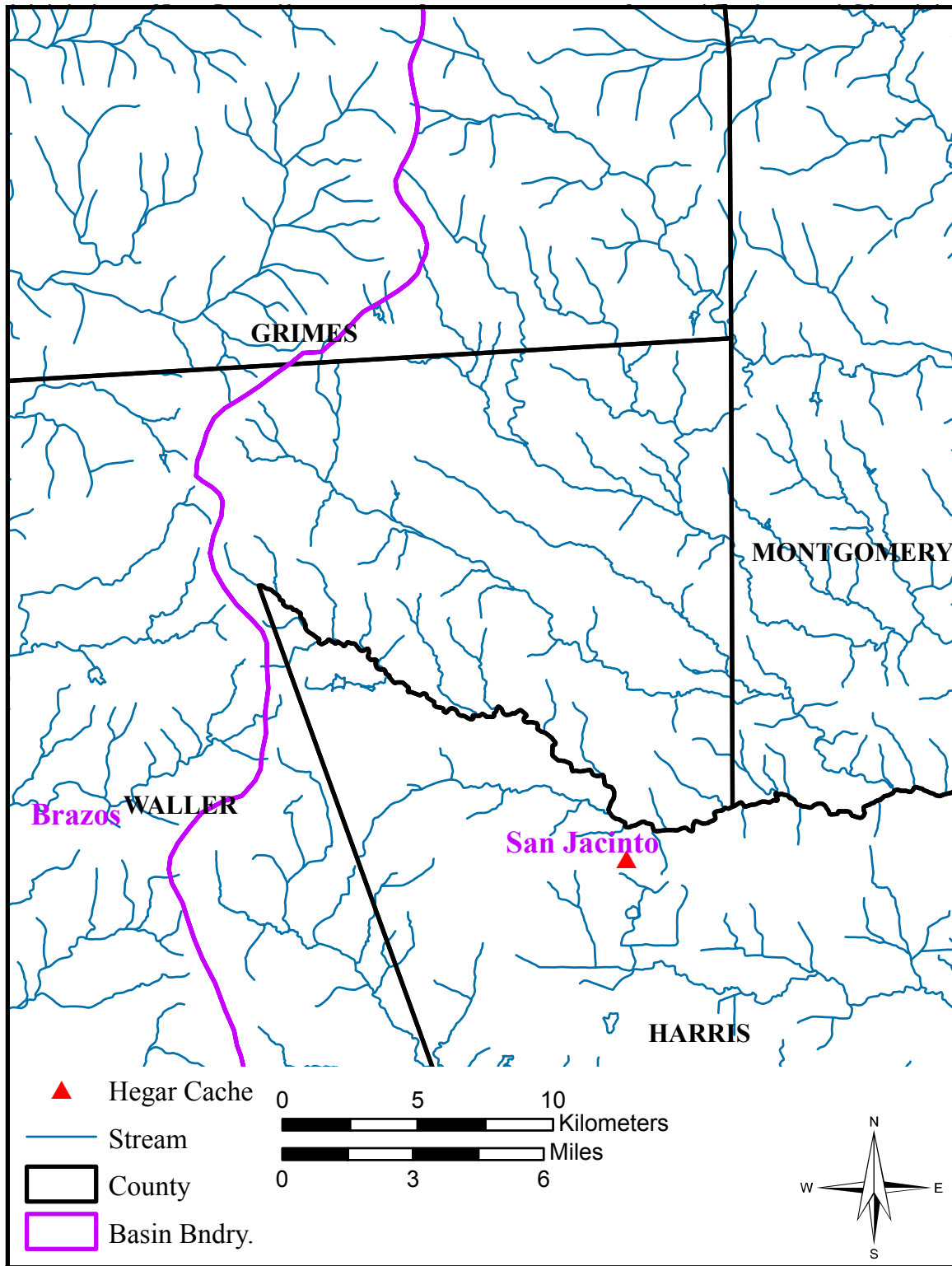


Figure 1. Hegar Site Location



Figure 2. Initial find photos

After the discovery of the bifaces by the Hegars, Texas A&M archaeologists found one biface in the stripped area, eight from the barn floor where Mr. Hegar deposited the initial scrapings, and Mr. Hegar provided another from his truck. All of the bifaces were made of Edwards Plateau chert identified as coming from the Junction, Texas area (Banks personal communication). Other artifacts found in the A&M investigations include a hammerstone, one chip, four secondary flakes, and nine tertiary flakes. The hammerstone is a stream rolled quartzite cobble with minor amounts of battering on the ends of the long axis. The chip and six of the flakes are similar material to the bifaces. The remaining seven flakes are a dark brown chert taken from a local pebble-size source material. All of the debitage is described in Appendix B.

#### Regional Cultural Prehistory and Previously Recorded Caches

It is important to review the regional cultural prehistory and the existing cache literature to better understand the spatial and temporal situation of the Hegar cache, relate the importance of the find to furthering the understanding of the regional prehistory, and raise new questions about the prehistory of the region. The Hegar cache is located at the boundary of the Savanna and Prairie Archaeological Region to the northwest of the site and the Southeast Texas Archaeological Region to the southeast of the site (Perttula 2004:7 figure 1.1) and at the modern environmental boundary of the Piney Woods, Gulf Prairies and Marshes, and the Post Oak Savanna. Documented prehistoric populations range from the Paleoindian (prior to 8000 B.P.) through the Archaic (8000 B.P. – 2000 B.P.), to the Early Ceramic (2000 B.P. – 1000 B.P.) and Late

Prehistoric (1000 B.P. to 300 B.P.) Pettula (2004:9). These cultural periods were based on changes in environment, technology, and/or population requiring cultural adaptations to meet varying circumstances. Unfortunately, cultural boundaries derived from archaeological data at this ecotone are scarce with few excavated sites to positively delineate margins. For example, Aten (1983:141) states there has been little significant data in the Upper Texas Coast since the 1950's and more recently Pettula (2004:10 figure 1.4) illustrates McFadden Beach as the closest significant Paleoindian site over 160 kilometers away and defined Archaic traditions (2004:11 figure 1.5) are over 80 km from the Hegar Cache location. This dearth of data extends over most of the cultural sequence leaving only the last 4000 of 12000 years reasonably well defined (Aten 1983:99; Fields 2004:349). Caches with discernible contextual information across Texas are even more rare than Angostura archaeological sites in the region. Although caches have been found in association with every cultural period, the location and content of caches varies dramatically over time and space. Lithic caches across the state have been found to include raw materials, flakes or blades, tools, and bifaces. The biface caches are most numerous and correspondingly have had the greatest amount of speculation to the purpose. Many were found in isolated context near prominent landforms, while others are found in habitation sites. Fewer were found in mortuary context although they were still called caches by the reporting archaeologist (Miller 1993:23). Most biface caches are exotic (non-local) material and are in early stages of reduction suggesting trade; however, large numbers of items in one cache can also be considered storage for later need or tools for insurance.

The Paleoindian period (prior to 8000 B.P.) is the earliest generally accepted cultural period in the New World and includes populations that inhabited North America from the Late Pleistocene to the Thermal Optimum in the early Holocene (Aten 1983:141). Paleoindians are thought to have been organized into small, mobile bands of hunters and gatherers that consumed a variety of plants and animals (Story *et al.* 1990:425). Availability and pursuit of accepted resources or the change to alternate resources is fundamental to the Paleoindian period (Kelly and Todd 1988) because these small bands traversed a wide territory to meet their dietary needs. Archaeological sites from the Paleoindian period include very portable bifacial and unifacial tools of high-quality material, sites with minimal amounts of debris, and widely dispersed projectile point types (Story *et al.* 1990:426). Paleo-Indian artifacts include widely distributed *Clovis*, *Folsom*, and *Plainview* projectile points (before 10,000 B.P.) and more regional *Texas Angostura*, *Meserve*, *San Patrice*, and *Scottsbluff* projectile point types (10,000 to 8,000 B.P.) along with Clear Fork gouges, drills, uniface cutting and scraping tools, choppers, hammerstones, and debitage (Perttula 2004:9 Table 1.1; Aten 1983:147; Ricklis 2004:184). Toward the end of the Paleoindian period populations along the Gulf Coastal Plain were more sedentary while Plains inhabitants retained a highly mobile hunting dominated subsistence strategy (Story *et al.* 1990:426). More detailed information is not available as Paleoindian artifacts are generally found either on the surface or in mixed context with later occupations leaving no excavated Paleoindian sites along the coast (Ricklis 2004:184). Although, locations like McFadden beach represent submerged coastal sites occupied as early as the Paleoindian period (Aten

1983:147). Paleoindian caches are limited to a biface cache at the Gault site (41BL323) and a blade cache at the Davis Blade Cache (41 NV659) in Central Texas although Clovis caches were recorded by Green (1963:150) in the southern High Plains as having a small number of large bifacially chipped knife-like items with either a single or double point and made of high-quality material. Hammatt (1970:141) describes how cached tools found on the Washita River may have been wrapped to protect the blanks and would therefore minimize wear from travel. In summary, as highly mobile groups with vague to non-existent cultural boundaries, Paleoindian caching would most likely focus on provisioning a place for future need or banking/insurance as described in Binford's Logistic Mobility model or as described in the Optimal Foraging Theory discussed further in the Conclusions chapter.

The Archaic refers to hunter-gatherers who implemented more regionally specialized approaches toward exploiting their environment but retained a hunting-gathering subsistence (Story *et al.* 1990:426). These cultural changes extend from the Thermal Optimum to the shift to modern climates (Aten 1984:76) and the introduction of ceramics and the bow and arrow (Ricklis 2004:185). Archaic period sites include repeat exploitation of seasonal resources with more expedient and fewer curated tools, and artifact distributions over a smaller range than the earlier Paleoindian period (Story *et al.* 1990:426). Restricted artifact distributions allow for temporal distinctions although temporal distinctions before 3500 B.P. are difficult as there are few sites with good context (Aten 1983:99). The Archaic is further divided into Early, Middle, and Late divisions. The Early Archaic (8000 to 5000 B.P.) is viewed as transitional from Paleo-Indian to



Archaic (Aten 1983:143 figure 9.1) with technology and population as the driving forces, requiring a greater emphasis on territoriality and a greater reliance on the inferior, local lithic resources (Aten 1983:154). Early Archaic points in the Southeast Archaeological Region include *Neches River*, *Trinity* and *Bell/Calf Creek* between 8000 and 5000 B.P. (Ricklis 2004:185 figure 6.3). The Middle Archaic (5000 to 3000 B.P.) subsistence strategies remained dependent on hunting and gathering economy with a greater reliance on native plants and an environmental shift to greater humidity causing population adjustments (Aten 1984:76). Along the coast *Bulverde* and *Perdenales* are typically associated with shell midden (Aten 1983:154) while *Bulverde*, *Yarbrough*, *Travis* and *Palmillas* are found across the entire region between 5000 to 4000 B.P. (Ricklis 2004:185 figure 6.3). The Late Archaic included increased population and restricted mobility between 4000 and 3000 B.P. with the eastern portion of the area remaining humid and the western portion of the area becoming more semiarid savanna (Aten 1983:159). Projectile point types associated with the Late Archaic include *Kent*, *Gary*, *Godley* and *Ensor* (Ricklis 2004:185 figure 6.3). The earliest examples of organized cemeteries come from the Middle and Late Archaic. Ricklis (2004:185) describes the Ernest Witte (41AU36) cemetery as having two distinct groups. Group 1 dates to the Middle Archaic and includes extended burials with few grave goods. Group 2 dates to the Late Archaic and includes flexed burials with Fairland and Ensor dart points, Corner Tang knives, boat stones, gorgets, pins, and beads. Aten (1983:154) describes the general population of cemeteries and burials beginning in the Archaic as severing as territorial markers on environmental boundaries. Caching in the Archaic would most likely be trade with inland groups for

utilitarian purposes as tools and projectile point styles were small and individuals were trying to make the serviceable edge on a tool last as long as possible. An item that would provide the greatest amount of useful edges would be most practical to trade. Miller (1993:4) concluded most biface caches were from the Middle to Late Archaic and cites hypothesis from several individuals suggesting larger numbers of bifaces may be stockpiling but fewer bifaces with flakes or tools may be for insurance. Non-local material is related to transport for trade (Miller 1993:24). Mortuary caching cannot be excluded as evidenced by 14 well-made lanceolate found in a cemetery at Loma Sandia (41KR241) in West Texas; however, the caches are in the cemetery and not part of a particular internment (Miller 1993:27).

The Early Ceramic period begins around 2000 B.P. with Tchefuncte ceramics from the Louisiana coastal region (Ricklis 2004:189) followed by the Late Prehistoric/Woodland period around 1300 B.P. with the bow and arrow. The introduction of these two technologies resulted in enhanced subsistence by allowing more resources to be harvested in a shorter time period allowing for longer stays at a location and the inevitability of establishing subdivisions within the environmental zone (Aten 1983:91). Increased regionalization resulted in diversity in decorating ceramics which lead to archaeologically discernable types beginning around 1900 B.P. (Aten 1984:77). The Tchefuncte ceramics changed into the locally derived Mossy Grove Tradition defined by Story (1990) which diversified further into six traditions described by Aten (1983:191) by 1990 B.P. and lead to the differentiation from the inland Tonkawa Bands and the description of territories for the Atakapa, Akokisa (Upper and Lower), Bidai, Coco,

Cujane, and Guapite (Aten 1983:31 figure 3.1). Of these the Coco, Cujan, and Guapite are considered Karankawa (Ricklis 1996:4). Specific to this study, Aten (1983:31 figure 3.1) shows the Hegar site location is within the Akokisa (upper) territory but the site is near the Buffer Zone with the inland Tonkawa Bands. The Akokisa and the Bidiai conducted balanced intervillage reciprocity (Aten 1983:70) between named groups (Aten 1983:82) but rarely with outside populations (Aten 1983:83) as trade was not necessary (Aten 1984:74) with increased use of bone and petrified wood (Aten 1983:148). When imported, lithic material was traded for items such as seaweed and used for utilitarian purposes (Aten 1983:148). Akokisa burials still included isolated internments, cremations, abandoned bodies, but cemeteries became increasingly important after 1350 B.P. as potential markers for entitlement to resources:

“...burials connects a group of individuals and the space and resources they perceive as their own with the realm of supernatural entities,... Mortuary ritual was a means by which survivors transmitted important messages about social order to other members of their own group, to adjacent groups, and the ever-present supernatural entities. It was a means of enhancing, or at least legitimizing, their power or rights vis-à-vis those of neighboring populations.” (Aten 1984:82)

Relations between the Akokisa/Bidias with the neighboring Tonkawa bands changed over time from peaceful to hostile as the Tonkawa initially fought against then allied with the Lipan Apache from the southern plains in the 19<sup>th</sup> century (Aten 1983:32). Finally, Spanish explorers (i.e., La Salle, Cabeza de Vaca, and others) provide some ethnohistoric accounts of native populations before Anglo expansion and influx of Eastern American Indian groups in the early part of the 19<sup>th</sup> century forced the extinction of the local populations (Aten 1983:33 figure 3.2). Caching in the Late Prehistoric is a continuation of

the practices established in the Archaic Period, but the volume of material is reduced significantly as people were not only making smaller arrow points and knives, but were using local petrified wood and bone instead of stone (Aten 1983:148). The late shift from allies to enemies between the Akokisa/Bidias and the Tonkawa forced a “hardening” of the boundary that resulted in less trade between the two parties.

### Spatial and Temporal Relationship of the Hegar Cache

The cache definition along with the Regional Cultural Prehistory and Previously Recorded Caches provide a basic framework to understand the spatial and temporal context of the Hegar cache. While the cache fits the general description of biface caches described by Miller (1993:22), there are several subjects in the description of the cache that are unique when framed against the cache definition and regional prehistory.

Caches are stored materials for later use by the living excludes items included in burials or votive offerings which will not be recovered as defined by Collins (1999), Kornfeld *et al.* (1990:301), Miller (1993:7), Schlanger (1981:4), and Tunnell (1978). When examining the site context and the artifacts there should be different characteristics depending on whether the cache is a store of material for later use, trade, or if it has a ritualistic purpose other than a burial or votive offering. Examining the function of the Hegar cache will rely on determining if it could serve in one or multiple functions. Determining the purpose of the cache will rely on the content, associated artifacts and features, and cultural affiliation of the cache.

If the Hegar cache is a collection of Angostura performs, then the cache represents one of only four sites with Angostura points in both the Savanna and Prairie Archaeological region and the upper Texas Coastal Archaeological region, based on the information provided by Bousman and others (2004:74 figure 2.46j) (Figure 3). The bifaces themselves would also represent the only documented Angostura performs or blanks in the region. The other three sites in the area, 41GM3, 41HR624, and 41CD122, all have mixed context with other cultural periods and projectile point types. Additionally, the Hegar Cache represents the closest cache of any period to the Gulf Coast (Miller 1993:48 Figure 1) and would provide additional evidence for late Paleoindian movement near the Gulf Coast. As a Paloeoindian cache, the Regional Cultural Prehistory suggest the Hegar Cache is provisioning a place for future need or banking/insurance and therefore should be part of a larger site in the immediate area.

If Hegar is from the Middle to Late Archaic or Late Prehistoric, than the bifaces are not Angostura. The cache is not a defined type, but it may be part of a boundary marker established by either inland or coastal populations separately or jointly. Caches in the region are rare. The closest caches of any kind is site 41HR365, a raw material cache of 35 cobbles near Spring Creek associated with arrow points followed by the Boggy Creek Cache in Washington County with four bifaces found in a Middle Archaic to Late Prehistoric midden with pottery (Miller 1993:Appendix I). Late Prehistoric occupations were utilizing lithics sparingly and were relying on expedient tools made from alternative sources (Aten 1983:300). Utilizing large bifaces as cores or to divide into smaller tools is impractical as the destruction of large bifaces would diminish its value. Large lanceolate

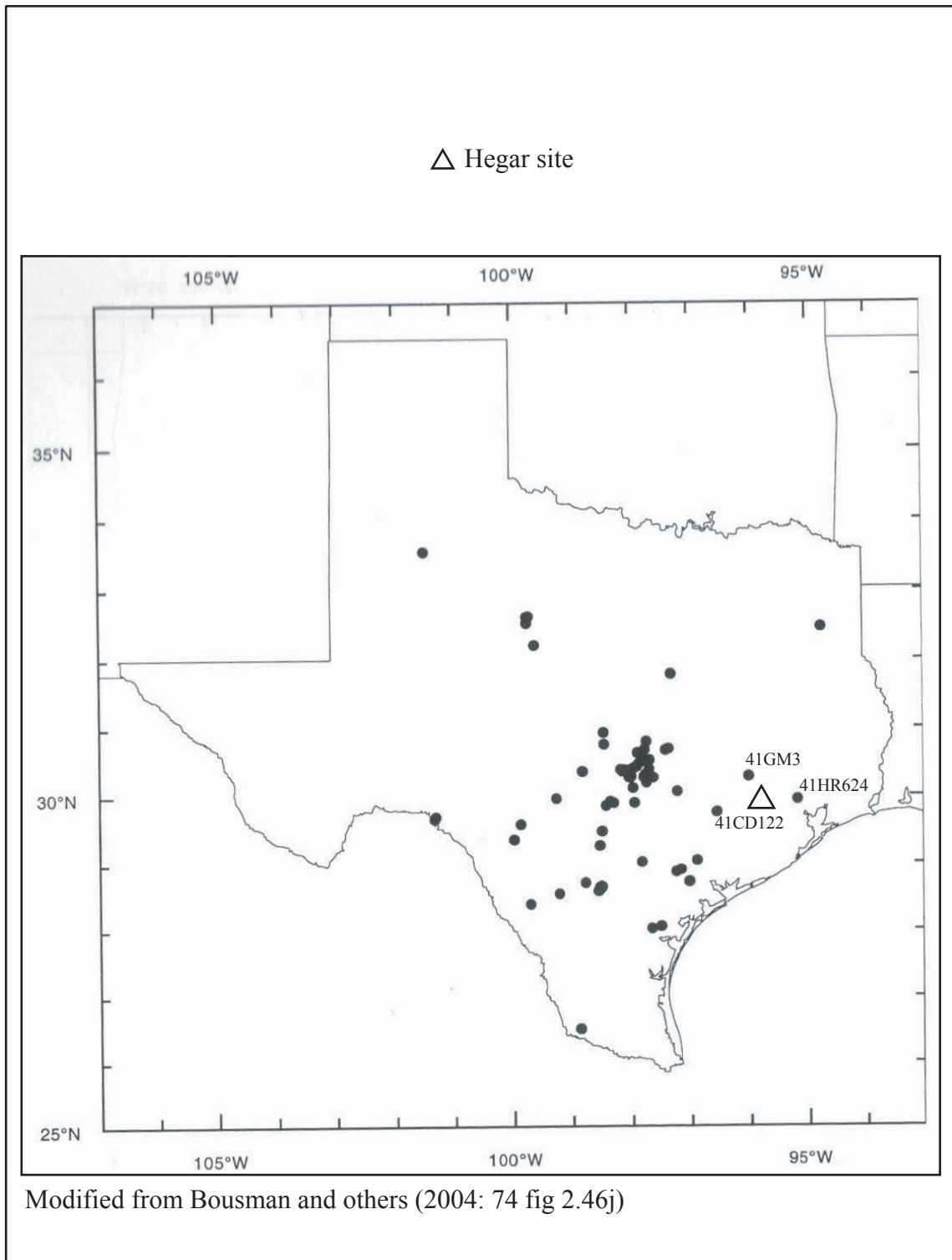


Figure 3. Sites with Angostura Points

bifaces would have a greater value whole both practically and symbolically in a lithic-poor region. Archaic and Late Prehistoric populations would most likely utilize the large bifaces for status or ritualistic purposes. As trade items, the cache may be near a cultural boundary but distant from any site to protect their exact location. As a status symbol, the cache would be near a larger site but still hidden to protect the contents but near enough to be recovered for display. The cache location, in a status or ritualistic purpose, would be known to few individuals and may be handed down over several generations. Ritualistic caching the cache may be both hidden and removed for ceremonial use or the cache may be part of a highly visible site visited by people from great distances as well as nearby.

In summary, the Hegar cache is important because there is little information about the area (Aten 1983:99; Fields 2004:349), it is on a cultural and environmental boundary, and the artifacts are unique in both material and technology for the area. Previous investigations of caches have generated speculation about the purpose of caches, but have not attempted to associate a cache with specific behavior(s).

## CHAPTER II

### EXCAVATION

The field work provided data to develop a model of site formation processes by understanding the geomorphic events that created the modern landform as well as evaluate and explore the site for intact cultural features and artifacts. Additionally, the field work included digging into the barn floor for artifacts picked up in the initial ground disturbance. This information lead to an understanding of how sediments were deposited and the effect geomorphic processes and soil formation had on site preservation. Excavation also defined the spatial extent of the cache and associated cultural material. Understanding site formation processes required investigating the geologic and paleoenvironmental setting of the region followed by collecting data from the site. Site data pertinent to understanding site formation included bucket auguring across the landform, Ground Penetrating Radar (GPR) survey near the stripped area, (2x1)m unit excavations on the landform, excavation of the stripped area and barn floor, and comparing profile and Optical Stimulated Luminescence (OSL) samples.

#### Geologic Setting and Paleoenvironment

The Hegar site is in the West Gulf Coast Plain. The geologic setting of this region includes a progression of Miocene to Holocene fluviodeltaic clayey and sandy deposits from the northwest to the southeast respectively. These sediments were primarily deposited by the Brazos River during eustatic sea level regression (Van Siclen



1991:657 Figure 5). Topography varies accordingly with wide rolling uplands and gentle slopes over narrow upland drainages to the northwest and coalescing flat wide floodplains to the southeast. Specifically, the geologic formations include the lower Pliocene Willis Formation to the north overlain by the middle Pleistocene Lissie Formation that is separated by the lower Pleistocene Tomball Coastal Terrace (Van Siclen 1991:657). This terrace is twice as old as the Lissie formation based on the eustatic cycle chart in Beard and others (1982:159 Fig 1.) dating between 1.7 and 2 mya (Van Siclen 1991:663 Fig 8). The major east-west ridge that holds the Hegar Cache was deposited as meander belt ridge; the remnant of an ancient levee of the Brazos River (Van Siclen 1991:656 Figure 4) while the lesser north-south ridge the Hegar site occupies is the result of erosion since the initial deposition of the levee material.

The paleoenvironment for southeast Texas is largely dependent on information from paleontological investigations of extinct flora and fauna as well as fossil pollen grains recovered from bogs and archaeological sites in central, northern, and west Texas. These deposits span the past 34,000 years. Little paleoenvironmental information is available from east Texas because few locations are sheltered from the environment and the acidic soil forming processes that produced Ultisols and Alfisols. Also, repeated wetting and drying often destroys pollen grains (Bryant and Holloway 1985:54). Given the lack of direct information about the region, only generalizations and simplifications of the environment are possible using data from adjacent ecological regions.

Beginning in the Wisconsin Glacial Maximum Period between 33,500 and 22,500 B.P., environmental data suggests that south and east Texas were at the boundary

between scrubby vegetation and grasslands to the west and deciduous forests to the east (Bryant and Shafer 1977:7; Bryant and Holloway 1985:44). Bryant and Holloway (1985:50) concluded that the environment was generally cooler and wetter than today's climate. Although the source of the rivers were not glacial run-off, Texas coastal plain rivers, e.g., Brazos, discharged cooler water into the Gulf of Mexico reducing the Gulf temperature and precipitation generated by warm water close to land as well as large scale tropical cyclonic events (Blum and Aslan 2005:182). The effective moisture during this period was derived from mid-latitude events that, when combined with the increased moisture, caused soil instability across the region (Blum and Aslan 2005:183).

The Wisconsin Glacial Maximum Period between 22,500 and 14,000 B.P. was a shift to forests in the region as vegetation change to more conifer, pine, and spruce trees (Bryant and Shafer 1977:11) in a semi-arid temperate woodland that covered central Texas, the northwestern gulf coast, and present-day southern Louisiana (Adams and Faure 1997:630, 637). This semi-arid temperate woodland included significantly cooler and moister summers but winters that were similar to present day temperatures (Toomey *et al.* 1993:305).

The Late-Glacial period from 14,000 to 10,000 B.P. saw rapid increases in temperature and associated decreases in effective moisture in three steps at 14,500 B.P., 12,500 B.P., and 10,500 B.P. which correspond with max meltwater discharge from glacier-fed rivers and decreased evaporation (Bousman 1998:212 fig 7; Toomey *et al.* 1993:306). The drier weather would lessen the recharge of rivers not supplied by glaciers, e.g., the Brazos and Colorado rivers, and may have reduced the flow to braided

streams allowing for more eolian movement of sediments. What is documented is these warming steps altered animal and plant life in the region with the return of grass-dominated setting (Bryant and Shafer 1977:14) and caused widespread landscape instabilities (Blum and Aslan 2005:183).

The Postglacial Period from 10,500 B.P. to present was a macroscopic continuation of the Late-Glacial Period with temperate grasslands in a savanna setting (Bryant and Shafer 1977:18) that extended from the gulf coast northward to Canada (Adams and Faure 1997:630, 637). Microscopically, the warmer temperatures and drier climate with a more grassland dominated environment around 9,500 B.P. (Bousman 1998:212 fig 7), stabilized briefly between 7,000 and 5,000 B.P. then continued the warming/drying trend causing animals that required more moisture to leave the area (Toomey *et al.* 1993:308).

In summary, the Hegar site is on a lower Pleistocene meander belt ridge deposited as a levee from the Brazos River between 1.7 and 2 mya (million years ago). After this initial deposition, the environment changed dramatically with documented alternations between woodland and grassland dominated vegetation regimes over the past 34,000 years. These geologically recent shifts in environment between forest and grassland increased soil instability as early as the Wisconsin Full Glacial including three periods of the Late-Glacial and one period in the Postglacial. Floral and faunal shifts from forest to grassland species include corresponding periods of soil instability as colluvial processes described by Cooke and others (2003) in central Texas and eolian processes described by Frederick and others (2002) in eastern central Texas.

## Excavations

Archaeological excavations on the Hegar site focused on developing a series of geomorphic events, defining the vertical and horizontal extent of the cache, and exploring the area for features and additional artifacts (Figure 4). This was done by examining data from four phases of field work:

1. Bucket augering on a 20 m grid and excavation of seven (50x50)cm units near the stripped area.
2. GPR survey near the stripped area.
3. Excavations of (2x1)m units between the stripped area and the summit of the landform.
4. Excavation of the stripped area and barn floor

In addition to the work outlined above, each phase began with a surface inspection of the stripped area. The initial surface inspection by the Hegars and Sharon Mendez revealed three clusters of artifacts along the last pass of the box blade excavation. More bifaces were found eroding out of the edge of a barn floor. The only other surface find was a biface discovered in the stripped area before the GPR survey. Subsequent block excavations placed the biface in block Q5 described in Phase 4.

### Phase 1 – Bucket Auger and (50x50)cm unit excavation

Bucket augering and (50x50)cm unit excavation was the first work performed by A&M archaeologists. This initial phase was intended to explore the landform for clusters of artifacts in undisturbed areas near the initial find in the stripped area and to collect data for a model showing the relationship between the surface and clay sub-surface. Both, (50x50)cm unit and bucket augering data sets included provenience along

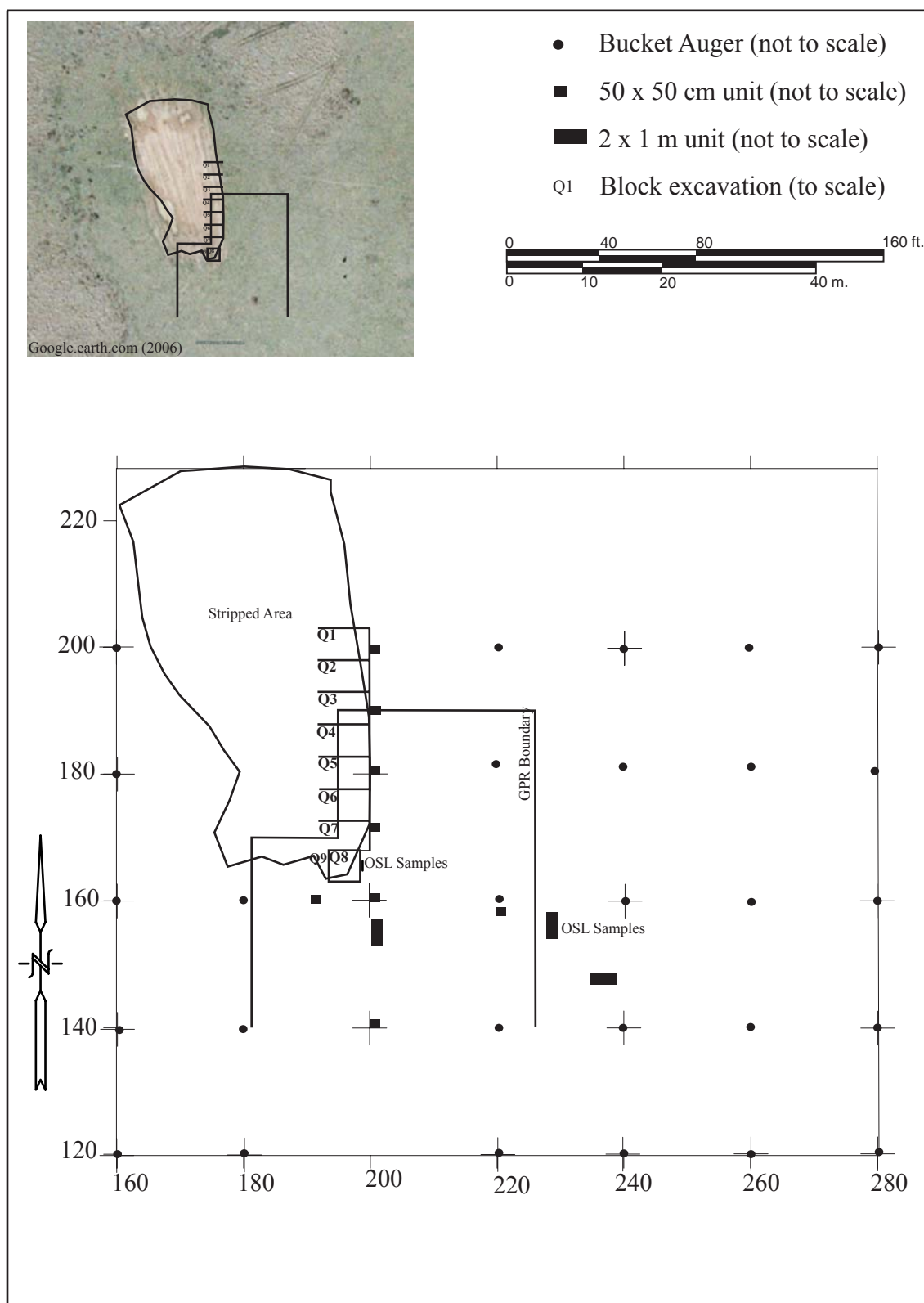


Figure 4. Hegar Cache Excavation Map

with notes describing the depth of changes in soil texture, color, and concretions. All matrix excavated from both (50x50)cm units and augering was screened through ¼ inch mesh wire cloth. No artifacts were found in either the (50x50)cm units or by bucket augering. Information from (50x50)cm units confirmed the bucket augering data and soil profiles in the stripped area. The depth of sandy soil material increased progressively in an upslope direction above the compact clayey sub-surface and gravel concentration stayed at the clay/sand contact surface.

Although the bucket augering and (50x50)cm units failed to find clusters of artifacts, the excavations did produce information for the depth to the clay horizon model. Bucket augering depth to clay data were compiled with surface elevation and location data to create a profile of the clayey sub-surface across the landform (Figure 5). The profiles revealed three details about the relationship between the surface sand and the sub-surface clay:

1. the sandy material is deepest near crest of the landform,
2. the clay sub-surface is neither level nor flat, and
3. the undulations in the clay sub-surface promote the formation of plinthite and water movement to the west and east of the site.

The sub-surface water movement promotes erosion of the overlying sands along the shoulder slope but leaves the summit intact. Aerial photo of the area (Figure 4) show vegetation changes north, east, and west of the site that conform to ground water seeping out of the landform near the toe slope forming drainage channels and promoting gradual erosion of the landform from the edges inward. Modern vegetation stabilized the ground

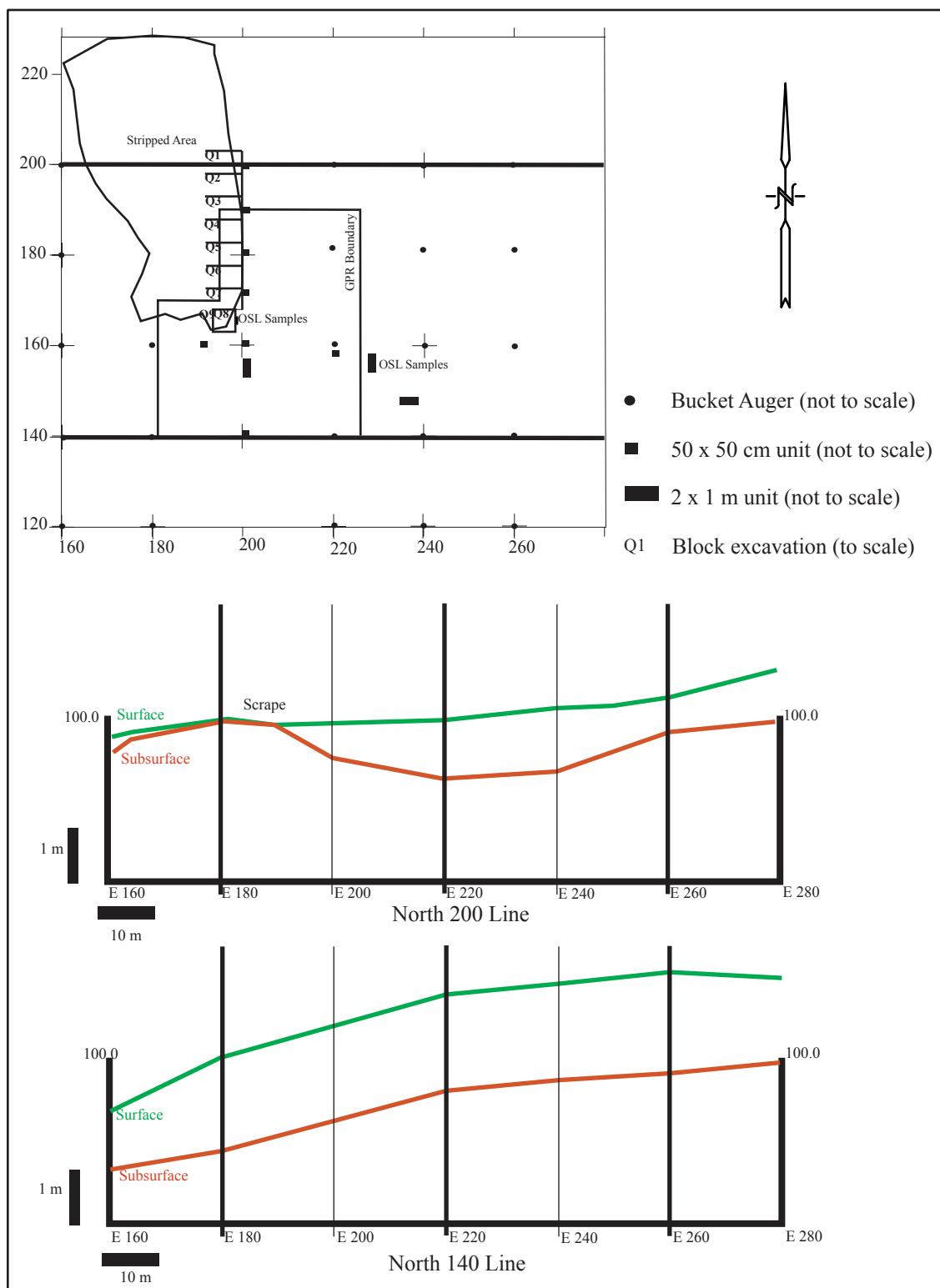


Figure 5. Surface and Sub-surface Profiles

surface and inhibited surface runoff. Subsurface water seeping to the surface near the toe slope of the landform continues to remove material and deflate the backslopes.

#### Phase 2 - GPR survey

Ground Penetrating Radar sends electromagnetic energy into the ground surface and records variations in the time (nanoseconds) it takes for energy to reflect off varying density of underlying material. While there are several factors influencing material densities in the survey area, the most important factor is the variation in water content throughout the matrix (Van Dam and Schlager 2000:435). Soil grain size and porosity directly affect density; therefore, disturbances from plowing, excavation and re-burial, rodents, insects, and roots create larger pore spaces as well as increased organic material. In-turn, water content varies and causes greater reflectivity with increased water content (Gawthorpe *et al.* 1993:422). Unfortunately, iron-rich minerals also increase reflectivity (Van Dam and Schlager 2000:435) thereby confusing interpretations.

Water and iron-rich minerals, in the form of plinthite, are present on the Hegar site. Soils on the site are Boy loamy fine sand (NRCS 2005). The Boy Series is a loamy, siliceous, thermic Grossarenic Plinthic Paleudalf formed in unconsolidated sandy and loamy materials. This series includes A and E horizons over a Btvg horizon (Clayey subsoil with plinthite and strong gleyeig). The B horizon is expressed locally by a red/yellow, clayey horizon with common amounts of pebble size plinthite gravel on the upper boundary. The B horizon and upper adjacent E2 horizon remain saturated for periods from 2 to 4 months in wetter times of the year. This soil is strongly to



moderately acid and is generally said to form under forests with acidic ground litter (Abbott 2001:32). Despite the water and plinthite complications, the area is classified as having a moderate to high GPR suitability index on site Ground-Penetrating Radar Segno Suitability Index (Soil Survey Staff 18 July 2006). To counter the effects of a saturated horizon the GPR survey was conducted in July when rain fall is historically documented as short duration showers when the soil column is considered driest.

Using the excavation grid and the mechanical excavation pit as a guide, the GPR survey was conducted on the undisturbed surface adjacent to the initial find with some overlap into the pit to provide a visual and GPR data model of the clay horizon. The GPR survey used a GSSI SIR3000 instrument pulled across the survey area along one-meter transects and provided overlapping coverage of each transect within 30 cm (12 inches) of the ground surface. Depth of penetration was 2 m (6.6 feet) below ground surface. Data were post-processed to create horizontal time-slices of the survey area at varying depths and vertical profiles of each survey line.

Time-slices, that is, planview maps of the GPR data, show increased reflection from iron-rich materials at increasing depths upslope (southeast) of the stripped area with increased intensity (yellow and red on the maps) (Figure 6). Combined with the auger data, the GPR survey shows plinthite at the sand/clay contact. The concentrations appear to progress with depth from the stripped area toward the summit. This is a product of decreasing depth of sand from the summit to the toe slope and a concentration of plinthite along the sub-surface ridge identified in the auger data. This subsurface

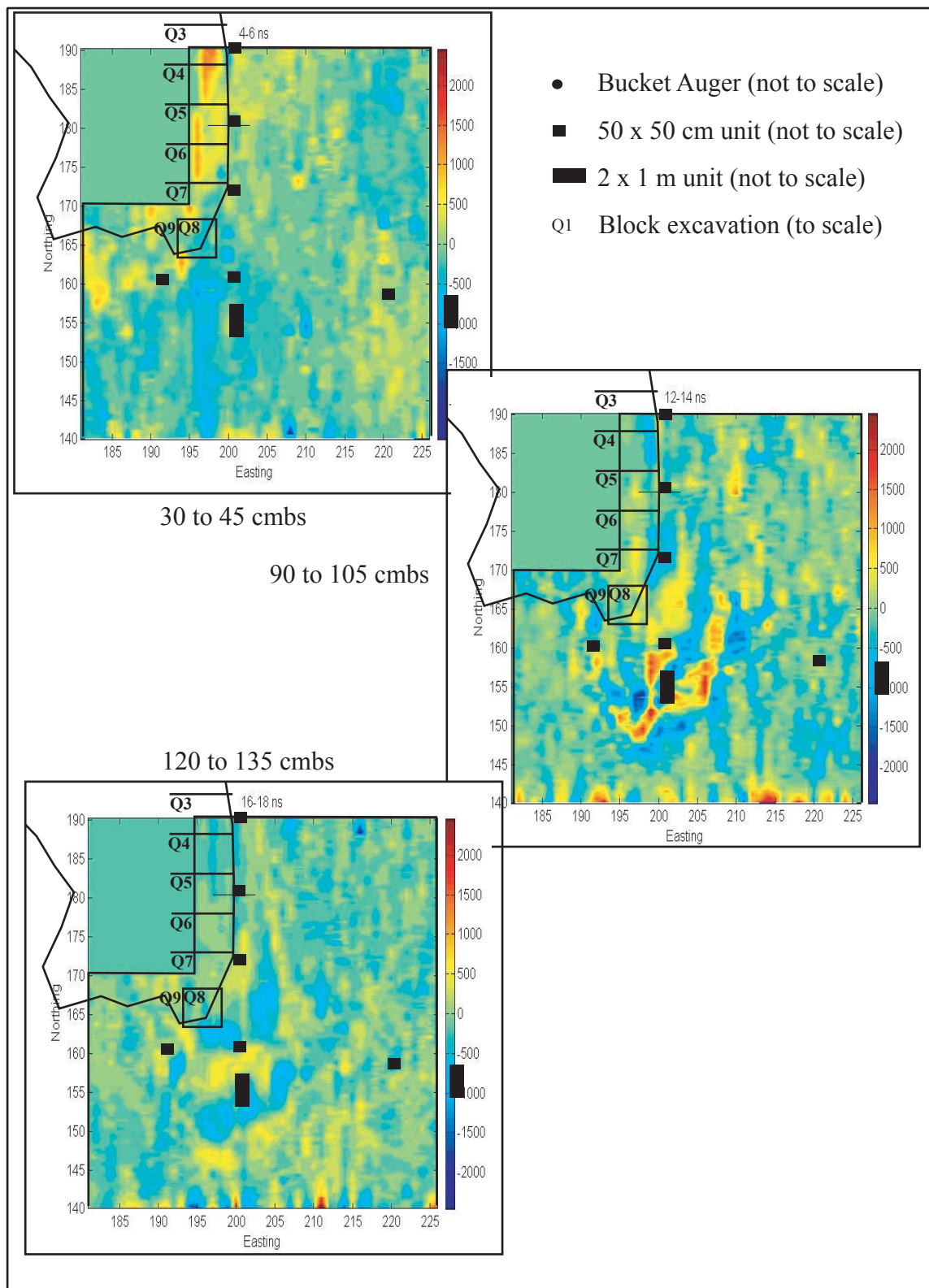


Figure 6. GPR Time-slices

ridge affects the visible surface in both the topographic map in Figure 1 and the air photo in Figure 4 as the back and shoulder slopes are slowly eroded.

The vertical line profiles show the upper 30 cm is highly disturbed with multiple alternating dark and light bands (Figure 7). These layers were interpreted as the plow/disking zone with high moisture and organic material content. Below the surface layer there are uniform lighter horizontal bands for the 30 to 75 cmbs depth range. Bands intensify in thickness and prominence between 75 and 100 cmbs similar to the upper 30 cm of the cross-section. Like the upper bands, this increased band width and intensity is associated with increased moisture in the soils 45 cm above the clay. Secondary plinthite concretions dot the profiles as chevron shaped disturbances with increased frequency closer to sand/clay contact. The clay layer appears as a gradual thickening horizontal bands between 120 and 140 cmbs. Below the clay horizon the horizontal bands blur and the plinthite concretions decrease in frequency with less water to stimulate their formation process.

### Phase 3 – (2x1)m unit excavations

Excavation of three (2x1)m units was conducted to find additional artifacts, investigate concentrations identified in the GPR survey; draw representative soil profiles of the summit and slope; and collect Optically Stimulated Luminescence (OSL) samples (Figure 4). Two of the units were placed on the summit while one unit was excavated on the slope near the initial find. The summit (2x1)m units were excavated at the highest elevation in close proximity to the site on an isolated portion of the ridge. The ridge is a

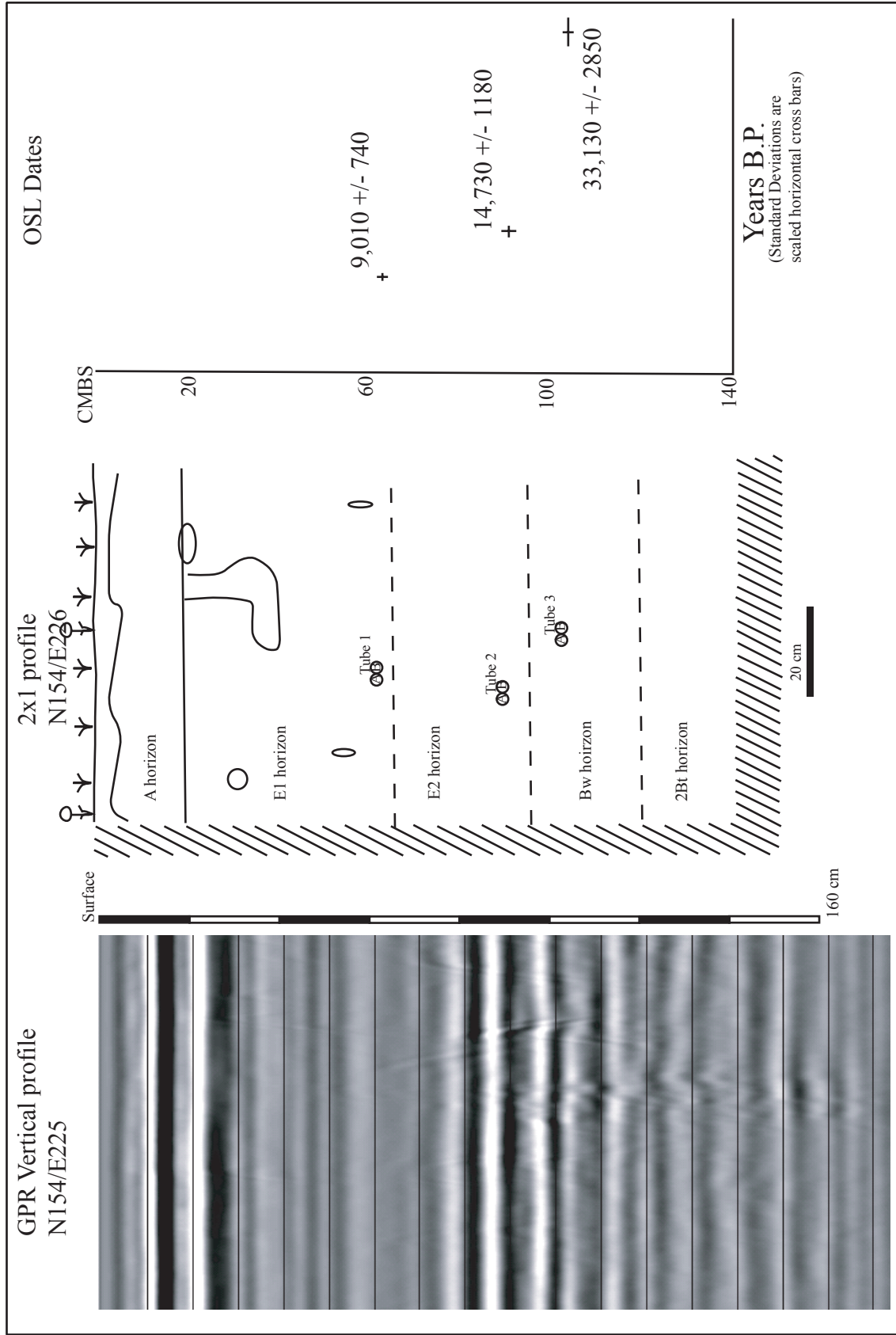


Figure 7. GPR Data from N154/E225, Profile of N154/E226 West Wall, and OSL Dates from N154/E226

wide, highly dissected, landform bound by intermittent drainages. The three summits of the ridge are separated by shallow draws which restrict colluvial soil movement leaving the stable material on the crest of the ridge. Late deposition was probable only grain-by-grain movement on gradual slopes. All excavated matrix was screened through ¼ inch mesh wire cloth. No artifacts were found in the (2x1)m block excavations. The profiles of the excavation units were consistent with loamy sand horizons separated primarily by color and secondarily by minor textural changes noted while troweling the vertical wall surface. The summit profile of N154/E226 included the following soil horizons:

Table 1. N154/E226 profile description

Strata	Soil	Description
II	A	0-20 cmbs; abrupt wavy boundary; dark reddish brown 5YR3/3 wet; loamy sand; friable; common rodent and earthworm disturbances, plow zone
II	E1	20-65 cmbs; clear wavy boundary; dark reddish gray 5YR4/2 wet; sandy loam; friable; fewer rodent and worm disturbances, OSL sample 1 taken near the lower part of this horizon at 63 cmbs.
II	E2	65-90 cmbs; diffuse smooth boundary; reddish brown 5YR5/3 wet; sandy loam; friable; OSL sample 2 taken near the lower part of this horizon at 90 cmbs.
II	Bw	90-120 cmbs; clear smooth boundary; brown 7.5YR4/4 wet; many medium distinct mottles; sandy loam; friable; few plinthite concretions; this horizon appears to be a gradient between horizons above and below, OSL sample 3 taken near the upper part of this horizon at 105 cmbs.
I	2Bt	120 + cmbs; light red 10YR7/8 wet; many coarse prominent mottles of dark red 10R3/6 and white 2.5YR8/1; sandy clay; firm; few plinthite concretions, truncated and buried Pleistocene surface.

The clear smooth boundary between the Bw and 2Bt along with the dramatic textural change and formation of secondary plinthitic concretions are indicators of a secondary deposition on the Pleistocene surface. Following the descriptions of Buol and others

(1997:334), plinthite is a soft red-and-gray mottled material that forms in an iron-rich clayey horizon that has a fluctuating water table. Exposure to repeated wetting and drying forms beds of irregular nodular aggregates. With increased erosion plinthite material forms a gravel layer. These lag-gravels are visible in the GPR survey time-slices on the surface of the previously exposed Pleistocene surface. This description is also consistent with the eroded Tomball terrace described by Van Siclen (1991:657).

Dating the sandy material on the summit relied on three OSL samples taken from horizons below major bioturbation zones in the upper 50 cmbs, as described by Balek (2002), and above the clay at 120 cmbs to avoid contamination of soil material from above or below. OSL and comparative bulk soil samples taken from the profile were submitted to the Luminescence Dating Research Laboratory, University of Illinois at Chicago for analysis. The laboratory used medium to fine-sized quartz grains for 29 to 30 single aliquot regenerative (SAR) analysis. The first and last doses were compared for each sample to test for sensitivity changes during the sampling. The compared samples coincided within the 1 standard deviation error limit. Errors using SAR are typically less than 5% and therefore limit errors in age to less than 10%. Dating the samples from the summit returned the following results:

Table 2. OSL results of N154/E226 profile. (See Appendix B for full data)

Sample No.	Lab No.	SAR	OSL Age <sup>1</sup>	Cmbs	Soil Horizon
Tube 1A	UIC1775	30	9010 $\pm$ 740	63	E1
Tube 2A	UIC1773	30	14,730 $\pm$ 1180	90	E2
Tube 3A	UIC1774	29	33,130 $\pm$ 2850	105	Bw

<sup>1</sup> 2000 AD datum; 95% confidence interval at  $\pm$  2 sigma.

The three OSL dates progress in age with depth as expected in a correct stratigraphic order from roughly 33,000 to 9,000 B.P. with 2-sigma confidence interval. Mixing of sand grains from bioturbation or sand in the 2Bt horizon is minimal as evidenced by the narrow standard deviation caused by greatly overlapping data from individual aliquots which not only gives reliability to the dates but the SAR method minimizes the effects of mixing (Leigh 2001:285) caused by bioturbation.

In summary the profile from the summit of the ridge found three important items in interpreting the age of the landform:

- 1) The overlying sand has little soil development although it is weathered,
- 2) The plinthitic concretions and GPR data sustain the exposure of the Pleistocene surface and the secondary deposition of sand by either colluvial or eolian processes,
- 3) OSL dates from the sand have similar results between aliquot tests indicative of minimal mixing from bioturbation or ground water level fluctuations and reliably dates the beginning of the sand deposition ca 36,000 and 30,000 B.P. during the beginning of the Wisconsin Full glacial and dates the latest OSL sample dates to ca 10,000 and 8,000 B.P. near the beginning of the Postglacial Period.

#### Phase 4 - Stripped area excavations and barn floor exploration

Excavations in the stripped area were an attempt to find additional artifacts and/or cultural features in a more controlled environment than the initial discovery.

Knowing that anything found in the barn floor was out of context, archaeologists cut the floor surface back from the edge in the areas the landowner deposited material from the site to see if any artifacts were present from the excavation site.

Excavations in the stripped area focused on leveling the floor and walls of nine quadrants along the east edge (Figure 4). Each quadrant was 5 m long and extended roughly 3 m westward into the excavated area from the E200 line. The northern most quadrant, Q1, had the northeast corner at N203/E200. Seven quadrants were excavated along the E200 line covering a total length of 35m to N168/E200. Two additional quadrants (Q8 and Q9) were excavated south and west of the E200 line. Q8 was south of and adjacent to Q7 but it included the 5m square area from N163 to N168 and E193.5 to E198.5. Q9 was a (3 x 2.5)m westward extension of Q8 from N165.5 to N168 and E190.3 to E 193.5. All excavated matrix was screened through ¼ inch mesh.

The excavations of roughly 33 cubic meters in the stripped area uncovered 15 artifacts of which seven were of the same Edwards chert as the bifaces. The remaining eight artifacts were from locally available materials and did not share any culturally diagnostic traits with the Edwards chert artifacts. Spatially, excavation of the stripped area did reveal three clusters of artifacts in Q3 (N188 to N193), Q5 (N178 to N183), Q7 (N168 to N173). Quadrant 3 artifacts included two thinning flakes of local material and three Edwards chert flakes. Quadrant 5 artifacts included two Edwards chert thinning flakes. Additionally, Biface 16 was found on the surface of the stripped area in Q5 at the time of the GPR survey. Quadrant 7 included four flakes two of which are Edwards chert. The largest Edwards chert flake of the collection, 60 mm in size, was found in Q7



roughly 8 cm above the Pleistocene clay horizon and 14 cm below ground surface. Two of the edges of this large flake show edge straightening. These three clusters of artifacts coincide with the three clusters of bifaces visible in a photo of the initial collection on the site by Sharon Menegaz (Figure 2). Other artifacts, including a fist-size quartzite hammerstone with light battering on both ends of the long axis and two chert flakes from local material, were found on the stripped surface before the block excavations began between Quadrants 8 and 9.

Excavations in the stripped area also documented a soil profile and an OSL sample from Quadrant 8 for comparison to the summit profile (Figure 8). Additional profiles were drawn from areas along the length of the E200 line; however, the soil above the Pleistocene surface thins quickly from the 70 cm of sand material in Quadrant 8 to only 30 cm of sandy soil in Quadrant 4 roughly 25 m downslope.

Like the summit profile, the profile of Q8 at N165/E198.3 was drawn, classified using soil taxonomy terminology, and an OSL sample was taken near the middle of the profile and submitted for dating. Unlike the summit profile, the soil horizon divisions were more obvious, relying on color and texture changes. The Bw and Bw/2Bt horizons are the boundary between the sandy material above and the clayey material below. Destruction of the unconformity is expected as the soil profile is only 70 cm deep and bioturbation is common on the landform. The boundary between the sandy material and the clay material is discernible as a lag-gravel concentration of plinthite near the boundary between the Bw and Bw/2Bt horizons. As discussed at the summit profile,

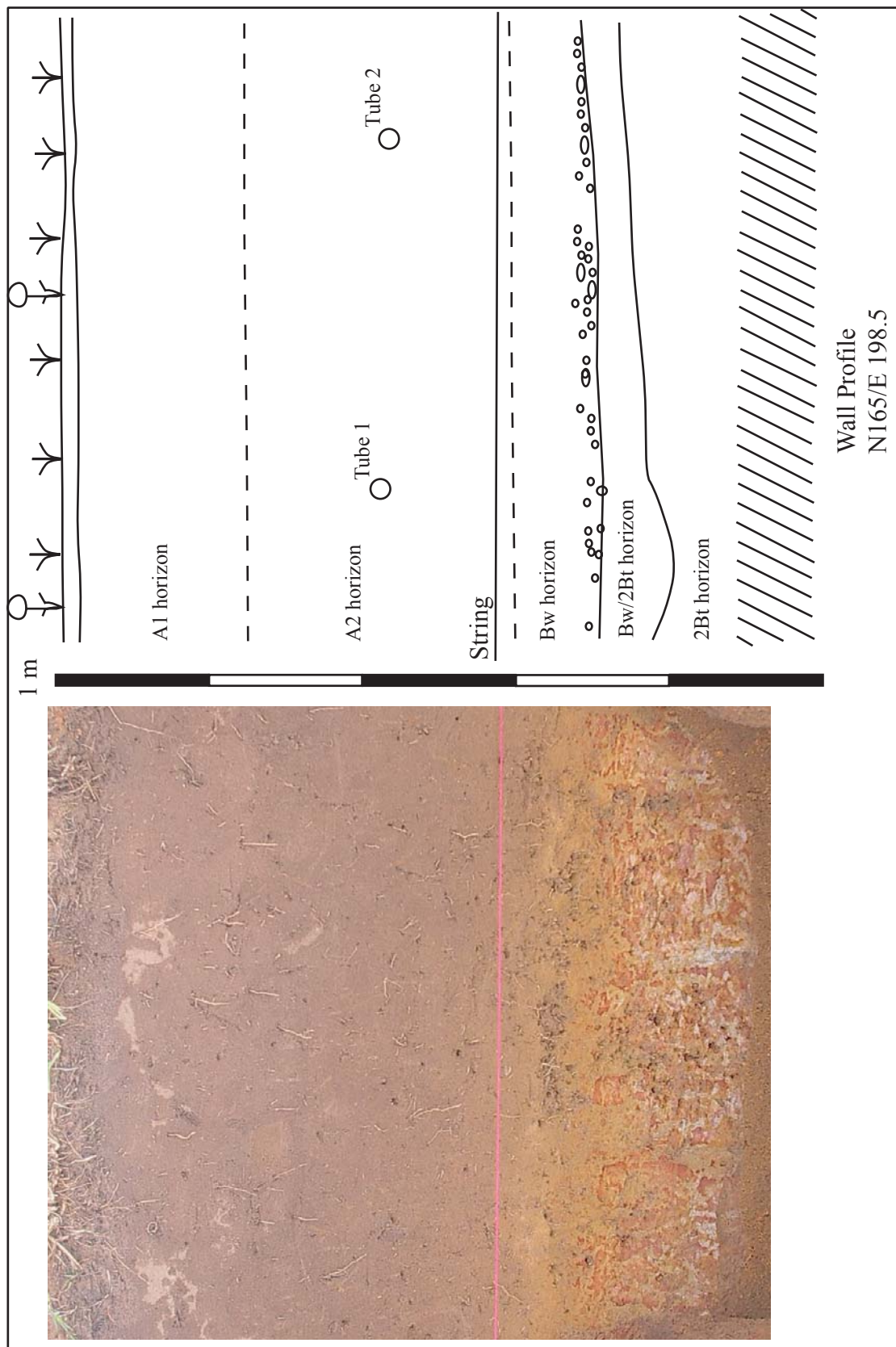


Figure 8. Profile of N165/E198.5

surface exposure increases the formation of plinthite. The common occurrence in an isolated area and well-rounded appearance is also indicative of a period of surface exposure.

Table 3. N165/E198.3 profile description

Strata	Soil	Description
II	A	0-25 cmbs; gradual smooth boundary; brown 7.5YR4/2 wet; loamy sand; very friable; common rodent and earthworm disturbances
II	A2	25-60 cmbs; gradual smooth boundary; brown 7.5YR4/3 wet; sandy loam; very friable; fewer rodent and worm disturbances, OSL sample taken near the middle of this horizon at 40 cmbs.
II	Bw	60-70 cmbs; gradual smooth boundary; dark yellowish brown 10YR4/4 wet; silt clay loam; friable; common, well-rounded, plinthite gravel forms a weak lag-gravel layer near the lower boundary of this horizon.
II	Bw/2Bt	70-80 cmbs; clear smooth boundary; light red 2.5YR6/6 wet; many medium distinct mottles of dark yellowish red 10R3/6; silt clay; firm; few plinthite concretions; white mottles in the 2Bt are absent.
I	2Bt	80 + cmbs; yellow 10YR7/8 wet; many coarse prominent mottles of dark yellowish red 10R3/6 and white 2.5YR8/1; sandy clay; firm; few plinthite concretions, truncated Pleistocene surface.

OSL dating of the profile at N165/E198.3 followed the same procedures as the summit profile by attempting to sample in the IIA2 below the heaviest bioturbation and above the mixing of material obvious in the Bw horizon. A sample was sent to the Luminescence Dating Research Laboratory, University of Illinois at Chicago for analysis and used the same sampling methods with 30 SAR. The sample returned the following results:

Table 4. OSL results of N165/E198.3 profile. (See Appendix B for full data)

Sample No.	Lab No.	SAR	SAR Age <sup>1</sup>	Cmbs	Soil Horizon
Tube 2	UIC1631	30	12,370 $\pm$ 860	40	A2

<sup>1</sup> 68% confidence interval at  $\pm 1$  sigma.

Like the summit profile, the similar dates from 30 individual aliquots suggests minimal sand grain mixing and an accurate sample of the age of the sediments at the location. Barn floor exploration focused on excavating the material taken from the eastern portion of the stripped area where the bifaces were found. Mr. Hegar remembered laying the material down along the outside edge of the barn where the roof drip line was eroding the floor. Some of the bifaces were found along the drip line by Mr. Hegar after the initial find in the stripped area. Archeologists began excavations from the drip line inward for 2 m skimming the floor surface and examining each shovel full for artifacts (Figure 9). A total of nine biface fragments, representing six of the 26 bifaces, were found within the first meter of the excavation inward from the drip line between the fourth and fifth support posts. No other artifacts were found in the second meter inward from the drip line neither between these posts nor in any other excavations along the rest of the floor.

The goal of the excavations were threefold: first, to explore the landform for intact cultural material and features; second, establish a set of geomorphic events that resulted in the current landform and allow an evaluation of the potential for finding intact cultural deposits; and third, explore the barn floor for additional artifacts. Archaeological investigations included systematic bucket augering to establish the variation between the ground surface and clay subsurface; GPR survey to search for



Figure 9. Barn Excavations

cultural features and variation in the soil; and excavation of (50x50)cm units, (2x1)m units, and block excavations along the landform and stripped area to find artifacts and features, and finally examination of the barn floor for additional artifacts. Unfortunately, none of the excavations recovered cultural features or intact artifacts.

To summarize, the excavations and bucket augering revealed that the sandy material is deepest near crest of the landform and shallower on the shoulder and back slopes showing deflation of the backslope through runoff and erosion. The GPR survey found plinthite concentrations along the clay/sand contact of the backslope and summit with increasing depth toward the summit and concentrating along sub-surface ridge identified in the auger data. OSL data from the excavation of (2x1)m units revealed that the sandy material on the summit was deposited in at least three episodes at 33,000 B.P., 14,000 B.P. and 9,000 B.P.. Stable sandy soil with only grain-by-grain movement of material is inferred by the overlapping single aliquot OSL dates. Block excavations in the stripped area found seven flakes of the same material as the bifaces and eight flakes of local material. All of the artifacts were found in blocks that corresponded to the locations of the clusters of the original biface discovery by Mrs. Hegar and Sharon Menendez but no further delineation of artifact distribution was possible given the small size of the collection. Sampling of a second profile in the stripped area revealed the sand at the cache discovery site has an OSL date of roughly 12,000 B.P.

## Discussion

Purpose of investigations was to place the site in a chronological and spatial context by examining the site formation processes and searching the area for material culture through artifact clusters and features. Site formation data included the depth to clay from the bucket augering, distribution of plinthitic gravels from the GPR survey, soil profiling descriptions, OSL dates, and interpretation of the regional geomorphology and paleoenvironment. The search for material culture relied on the GPR survey; excavating (50x50)cm units, (2x1)m units, and the stripped area; and excavating the barn floor.

## Site Formation

Geologically, the Hegar site rests on the remains of an ancient east-west meander belt ridge of the Brazos river that was deposited as a levee in the lower Pleistocene (Van Siclen 1991:657 Figure 5). Since this initial deposition between 1.7 and 2 mya successive events of destabilization through erosion of the back slopes and stabilization through colluvial movement of the upper sandy deposits of the levee brought the landscape to its current form. The culmination of evidence from excavations show how the landscape was reduced through geomorphic and climate changes.

The topography of the area suggests headward erosion, into the ancient deposits, created ancillary north-south trending ridges defined by the drainage channels visible on the topographic map. This erosion cut into the lower clayey deposits and destabilized the overlying sands on the slopes of the ancient levee. Headward erosion removed the

overlying sandy deposits on the back slopes and eroded the Bt subsurface topography to the undulating surface identified in the bucket augering. With the subsurface exposed on the backslope and shoulder of the ridge, the remaining sand on the summit filled the depressions and covered the exposed 2Bt surface simultaneously stabilizing the subsurface and normalizing the ground surface slope reducing erosion to the modern creep movement instead of the mass wasting. This model is depicted in Figure 10 and described in the following paragraphs.

Evidence for the initial headward erosion includes the differences between the surface and subsurface topography found in the bucket augering. The headward erosion created gullies in the 2Bt and the removal of sand from the backslopes as modeled by Thoms and Olive (1993:76 fig 6.13) citing Waters (1992:303) description of soil creep. The original depth of the sand on the crest of the ridge as well as when and how many times this sequence of mass-wasting/stabilizing event occurred is unknown. What can be said is that after the latest erosion there was still a ready supply of sand on the crest of the ridge, headward erosion into the backslope and shoulder removed the sand from the slope and shoulder, and contoured the underlying clay. The result was a steep slope with a firm foundation and loose material stored nearby on the summit sometime before ca. 33,000 B.P.. This corresponds with the Wisconsin Full Glacial Period when south and east Texas were at the border of scrubby vegetation and grasslands to the west and deciduous forests to the east (Bryant and Shafer 1977:7; Bryant and Holloway 1985:44) at a time of soil instability across the region (Blum and Aslan 2005:183) and at the end



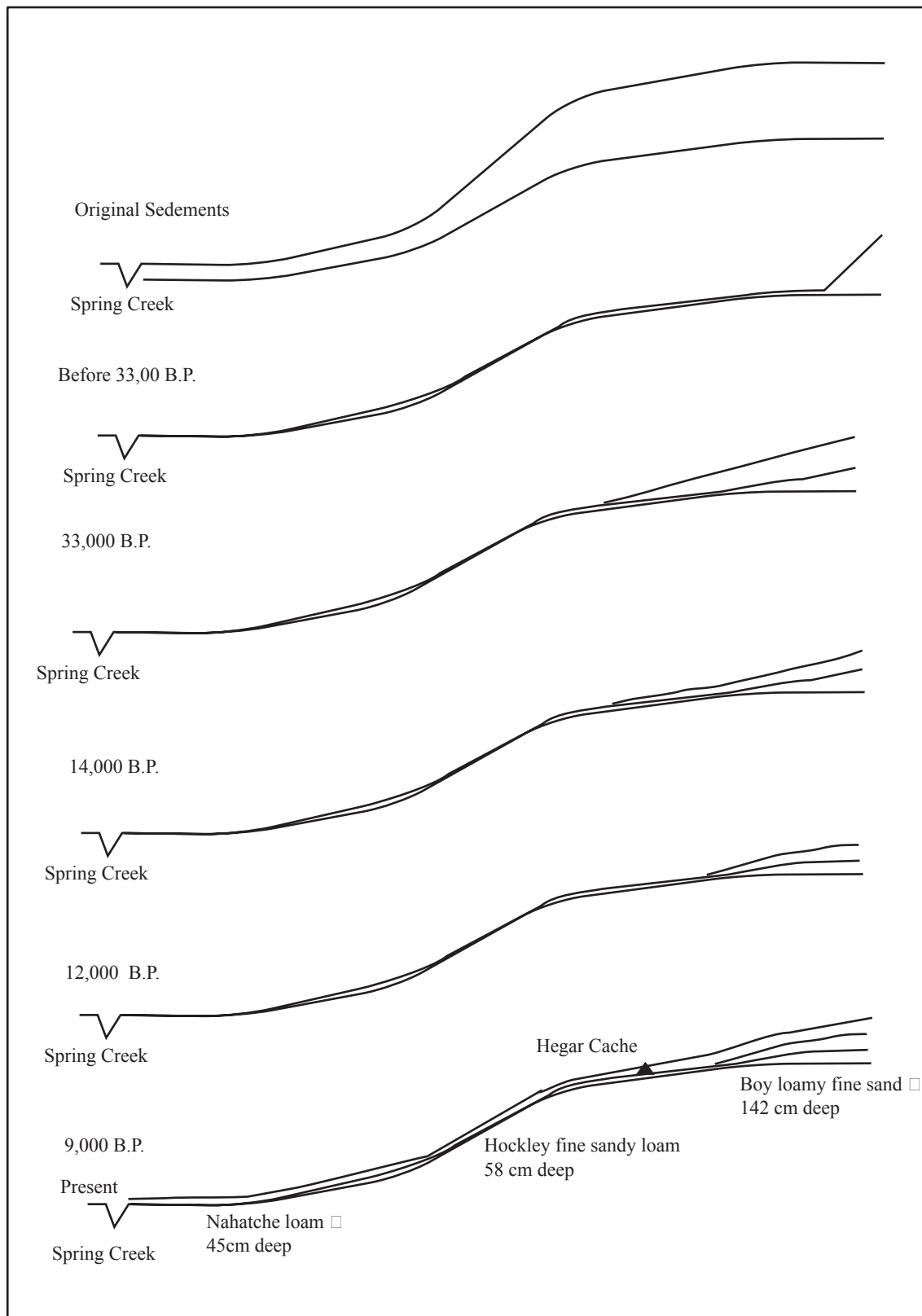


Figure 10. Site Formation Process

of the H4 Heinrich Event which occur after Dansgaard-Oeschger oscillations, that is, rapid global warming that affect climates world wide (Clark *et al.* 1999:1106).

Colluvial movement continued periodically for the next 24,000 years with each movement caused by environmental instability and each surge lessening in the amount of sand deposited between the shoulder the summit of the ridge. The last episodes of colluvial movement recorded in the soils profile OSL dates of  $14,730 \pm 1180$  B.P.,  $12,370 \pm 860$  B.P., and  $9010 \pm 740$  B.P. correspond with rapid increases in temperature in three steps at 14,500 B.P., 12,500 B.P., and 10,500 B.P. described by Bousman (1998:212 fig 7), Toomey and others (1993:306), and Richardson (2001:390). Higher resolution of information from nearby Boriack bog in Lee County and Weakley bog in Leon County show changes from woodland to grasslands and back to woodlands at 15,500 B.P., 12,500 B.P., and 9,500 B.P. followed by extended period of grasslands beginning at 8,000 B.P. (Bousman 1998:212 fig 7).

Evidence for the exposure of the 2Bt surface and subsequent colluvial deposition of sand includes the GPR data and soil profiles. The GPR data included horizontal time-slices showing a lag-gravel at the contact surface (Figure 6) and the vertical GPR profiles in Figure 7 show dark bands near the surface and between 80 and 100 cmbs consistent with changes in density caused by water in pore spaces. The dark bands near the surface are caused by modern disking while the bands at depth may be caused by different colluvial pulses. Within the soil profiles, the clear smooth boundary between the clay and sand as modeled by Sorensen and others (1976:46) to represent a discontinuity. The reason there have been no obvious mass wasting along the slope in

modern times is that the modern slope between the summit and the shoulder have a slope of less than two percent which, according to Leigh (2001:272), is considered a stable surface and not prone to colluvial movement. Combining the summit profile, other excavation information, and environmental data in the following summary table:

Table 5. Site formation processes

Strata	Time	Event	Profile
II	Holocene	Continued thinning of backslope and bioturbation moves artifacts to Bt surface	Bifaces found near 2Bt in thin sand veneer.
II	Paleoindian to Early Archaic period	Cache deposited	Bifaces and other debris left on site
II	OSL dates of 33,130 B.P., 14,730 B.P., and 9,010 B.P.	Sand deposited colluvially on Hegar site, forms discontinuity with underlying Bt, and stabilizes slope	Episodic deposition of sand from summit. A through Bw horizons
I	upper to middle Pleistocene	Gullieying erosion into the sides of the ridge and progressing up/inward	Exposure of the Bt surface and steepening backslope
I	lower Pleistocene	Brazos River Deposits Meander belt ridge	2Bt deposited

With 24,000 years of relative stability and minor colluvial movement onto the Hegar site it is expected that a Bt horizon should form in the new sand and that there would be a thickened toe slope. The absence of a well formed Bt horizon in the sand over the Pleistocene surface is attributed to a lack of clay particles originally deposited with the sand and the resistance of sand to weathering; additionally, burrowing animals frequently mound material on the surface offsetting soil horizon development. Flora

and fauna action on the site was evident in multiple mammal and insect burrows with plinthite concretions from the contact surface. The blending of pedogenic horizons into an almost uniform sandy loam over the clay observed in the profiles, and described by Leigh (2001) and Balek (2002) as evidence of bioturbation. Bioturbation effectively destroys evidence of sediment deposition and profile development in the upper sands.

In summary, the site formation study shows the modern ridge is the result of an unknown number of erosional and colluvial depositional events although aeolean sand deposition cannot be rejected. Like the paleoenvironmental research in the region, there is little information predating the last Glacial Maximum. Bucket augering data illustrated that the 2Bt horizon was not a flat surface, but one that undulated from headward erosion before the visible colluvial pulses of sandy material from the summit. GPR time-slice (horizontal images) data found concentrations of plinthitic lag gravels on the 2Bt surface indicative of an eroded exposed surface and the vertical GPR profiles illustrated changes at density in the soil column at depth that correspond to dated soil horizons. OSL samples from the soil profiles returned dates of ca 33,300 B.P. 14,700 B.P., 12,400 B.P., and 9,000 B.P.. The 33,300 B.P. date is the earliest colluvial deposit and corresponds with a global warming oscillation which resulted in soil instability (Blum and Aslan 2005:183) followed by other documented warming trends with associated soil instabilities near the 14,700 B.P., 12,400 B.P., and 9,000 B.P. dates. Unfortunately, the shallow nature of the soils at the actual cache find combined with bioturbation limits interpretation of the cultural sequence of events except to say the latest observable colluvial movement was between 9,850 and 8,270 B.P. and Angostura

points from datable context are typically found on sites between 8,500 and 8,000 B.P. (Turner and Hester 1985:66). The bifaces may have been buried in the preceding 12,400 B.P. sediments which were subsequently eroded displacing the bifaces from their original context then reburied by colluvial sediments as late as 8,270 B.P., or the bifaces may have been buried in the roughly 9,000 B.P. sediments and bioturbation and Mr. Hegar's box-blade disturbed the bifaces in the shallow soils.

### Spatial Distribution

Material culture on the Hegar site is limited to the 26 Angostura-like bifaces, a hammerstone, and 15 flakes. Block excavations in the stripped area revealed the flakes were found in the same 5mx5m quadrants as the bifaces. The flakes include seven of the same Edwards chert as the bifaces and the remaining eight were from local gravel sources. Although many, for example, Leigh 2001, Balek 2002, and Johnson 1993, have illustrated how artifacts from different occupations can become mixed as pedoturbation causes materials to coalesce in the bottom of disturbances, the coincidence of two occupations placing artifacts in the same 5 m areas and not in adjacent and connecting areas is incalculable. It is more acceptable to assume that both the exotic and local materials were deposited or left behind at the same time and that their concentrations, while limited, have some interpretive value based on the quantity of material at a given location. Without associated features or larger artifact concentrations there is little to say about the purpose of the cache. The data from the Hegar site is similar to descriptions of other isolated finds, for example, Miller 1993:28; Lintz and Saner

2002:36. Potential behaviors associated with three clusters of bifaces and scant lithic debitage from exotic and local materials is explored in the Caching Behavior chapter.

## Summary

The archaeological excavation of the Hegar Cache focused on placing the site in a temporal and spatial context by describing the site formation processes to arrive at a meaningful inclusion into regional and broad-spectrum studies. Sampling and excavating revealed that artifacts were found in three distinct clusters on the shoulder slope of a ridge that was deflated and covered with sandy material in several episodes of soil instability associated with climatic changes beginning as early as 33,130 B.P. with the deposition of sandy material over an exposed clay sub-horizon. Episodes of erosion and deposition continued until about 9,000 B.P. when the summit became isolated and slope decreased the rate of erosion to grain-by-grain along the toe slope. Therefore, the cache depositor(s) saw a similar landscape to the modern setting, but may have experienced a greater depth of sand. These deep sandy soils are not indicative of feature preservation because of the strong acidic content, sand movement down slope, and bioturbation. In the absence of more information about the proximity of any large sites, the Hegar cache best fits the description of an “isolated find” and may have been a storage of ceremonial items destined for trade to several nearby populations in a lithic poor region of the gulf coast.

### CHAPTER III

#### BIFACE ANALYSIS

The cache analysis includes collecting metric, morphologic, and micro-wear data to frame the bifaces in a stage of production and use. Metric measurements are obtained by measuring length, width, and thickness using electronic calipers or a millimeter graded ruler for measurements larger than the caliper capabilities. Width and thickness measurements are taken at several locations for each axis and the maximum value recorded. Edge angle is measured by examining each biface from the base or tip and measuring the edge angle similar to Collins (1999:84) with an angle scale.

Morphological attributes are evaluated by comparing the flaking patterns to reduction models and biface stages proposed by Young and Bonnicksen (1985), Callahan (1979) and Bradley and Stanford (1987). Low power micro-wear analysis is conducted with a Leica MZ12.5 microscope with a range from 8X to 100X and high power examinations are made with a Leica DMLA microscope with a range from 100X to 500X.

Micrographs are made with a Cool Snap Pro camera and software that combines several sequential images of the same location at different focal lengths to provide an extended depth of field of the subject. Data collected from the bifaces is presented in Appendix A.

The biface material is identified as Edwards chert. While the exterior of the bifaces are moderately to extremely weathered, examination of a freshly broken surface under black light and with a hand lens reveal the material is a grayish brown chert with

white inclusions and fusulinid fossils (Banks 1990:124; personal communication). The sample submitted for analysis is identical to a sample collected from the Farmers Ranch roughly 42 kilometers north of Junction, Texas and photographed in Plate 6 of *Mountain Peaks to Alligator Stomachs* (Banks 1990:124; Banks personal communication). While this comparative analysis does not suggest the individual(s) caching on the Hegar site visited the Junction area, it does suggest the individuals obtained the material from the western portion of the Edwards Plateau and quite possibly from a chert ledge or location with cobbles/boulders over 30 cm thick as most of the bifaces have a uniform thickness from tip to base and the longest specimen almost 28 cm long.

#### Metric Attributes

The metric data is presented in Table 6 along with ratios of length/width, width/thickness, and length/thickness. Table 6 also includes notes of each biface's completeness. Completeness is described as Partial, or Broken; a partial biface is missing a segment of the item while a broken biface may be in several pieces but all were recovered.

Table 6. Biface metric data and ratios

Biface #	Dimensions (mm)			Edge Angle	L/W ratio	W/T ratio	L/T ratio	Completeness	
	Length	Width	Thickness					Partial	Broken
1	142	50	12	30	2.840	4.167	11.833	Y	Y
2	135	48	13	40	2.813	3.692	10.385	Y	Y
3	136	55	15	40	2.473	3.667	9.067	Y	Y
4	119	51	13	35	2.333	3.923	9.154	N	N
5	240	52	14	40	4.615	3.714	17.143	N	N
6	180	54	16	45	3.333	3.375	11.250	N	N



Table 6. Continued

Biface #	Dimensions (mm)			Edge Angle	L/W ratio	W/T ratio	L/T ratio	Completeness	
	Length	Width	Thickness					Partial	Broken
7	224	50	16	45	4.480	3.125	14.000	N	Y
8	196	60	15	45	3.267	4.000	13.067	N	N
9	201	55	16	45	3.655	3.438	12.563	N	N
10	232	52	15	50	4.462	3.467	15.467	N	N
11	243	53	14	45	4.585	3.786	17.357	N	Y
12	268	54	16	45	4.963	3.375	16.750	N	N
13	108	56	12	30	1.929	4.667	9.000	N	N
14	164	56	11	35	2.929	5.091	14.909	N	N
15	195	53	14	35	3.679	3.786	13.929	Y	Y
16	169	58	16	40	2.914	3.625	10.563	N	N
17	279	59	16	45	4.729	3.688	17.438	N	N
18	241	48	12	40	5.021	4.000	20.083	N	Y
19	174	55	14	40	3.164	3.929	12.429	N	N
20	180	58	14	45	3.103	4.143	12.857	N	Y
21	321	49	14	35	3.184	3.500	11.143	Y	Y
22	279	61	15	45	4.574	4.067	18.600	N	Y
23	185	51	13	40	3.627	3.923	14.231	N	Y
24	216	49	15	40	4.408	3.267	14.400	N	N
25	167	59	15	35	2.831	3.933	11.133	N	Y
26	118	58	17	35	2.034	3.412	6.941	Y	Y

Overall, the bifaces are lanceolate or leaf shaped with poorly defined tips and bases.

Bases are distinguished from tips as having relatively wide outlines and, where possible, original flake platforms are observed. Biface thickness is generally uniform varying only a few millimeters from tip to base. Large thinning flake scars generally terminate near the middle of each bifaces, but the midline is not well defined. Flake scars that terminate past the midline are common although true overshoot flaking to remove material from the opposite edge are few. Smaller flake scars along the edges are between larger flake scars and are attributed to edge strengthening before removing

larger thinning flakes. This reduction sequence leaves the edges centered laterally but either sinuous or broken by more recent large thinning flakes removed from either face. Rounded hinge and step fractures dominate the edges between thinning flake scars and edge angles are steep. These thick edge sections opposite well defined ridges are setting up the next sequence of flake removals to further reduce the biface thickness. Based on observation alone, the collection included three groups: Group 1 with long narrow bifaces, indistinct (similar outlines) tips and bases, with parallel to slightly convex lateral edges, and includes biface numbers 2, 5, 7, 10, 11, 12, 15, 17, 18, 21, 22, 23, and 24 (Figure 11); Group 2 with relatively shorter and wider bifaces, more clearly identified tips and bases, one large flake dominates the tip remnant of early reduction, with distinct convex lateral edges, and includes biface numbers 3, 4, 6, 8, 9, 14, 16, 19, 20, 25 and 26 (Figure 12); and Group 3, numbers 1 and 13, which were prehistorically broken and reworked (Figure 12). Biface 1 has reworked basal snap fracture. Biface 13 is a “half-moon” shape but the overshot flake scars that dominate the face suggest this is a reworked midsection of a larger biface broken early in production.

Inclusion of a biface in a particular group is based on a combination of size (length vs width ratios) as well as outline (convex vs straight sides), and flaking patterns (distinct vs indistinct tips and bases). Beyond these gross groups, there is little to distinguish the bifaces as their total lengths and widths are more or less continuous with Biface 21 the longest by 42 mm, and Bifaces 13 and 4 distinctly shorter by 45 mm than the remainder of the complete bifaces. Flaking patterns show no grouping or trends with

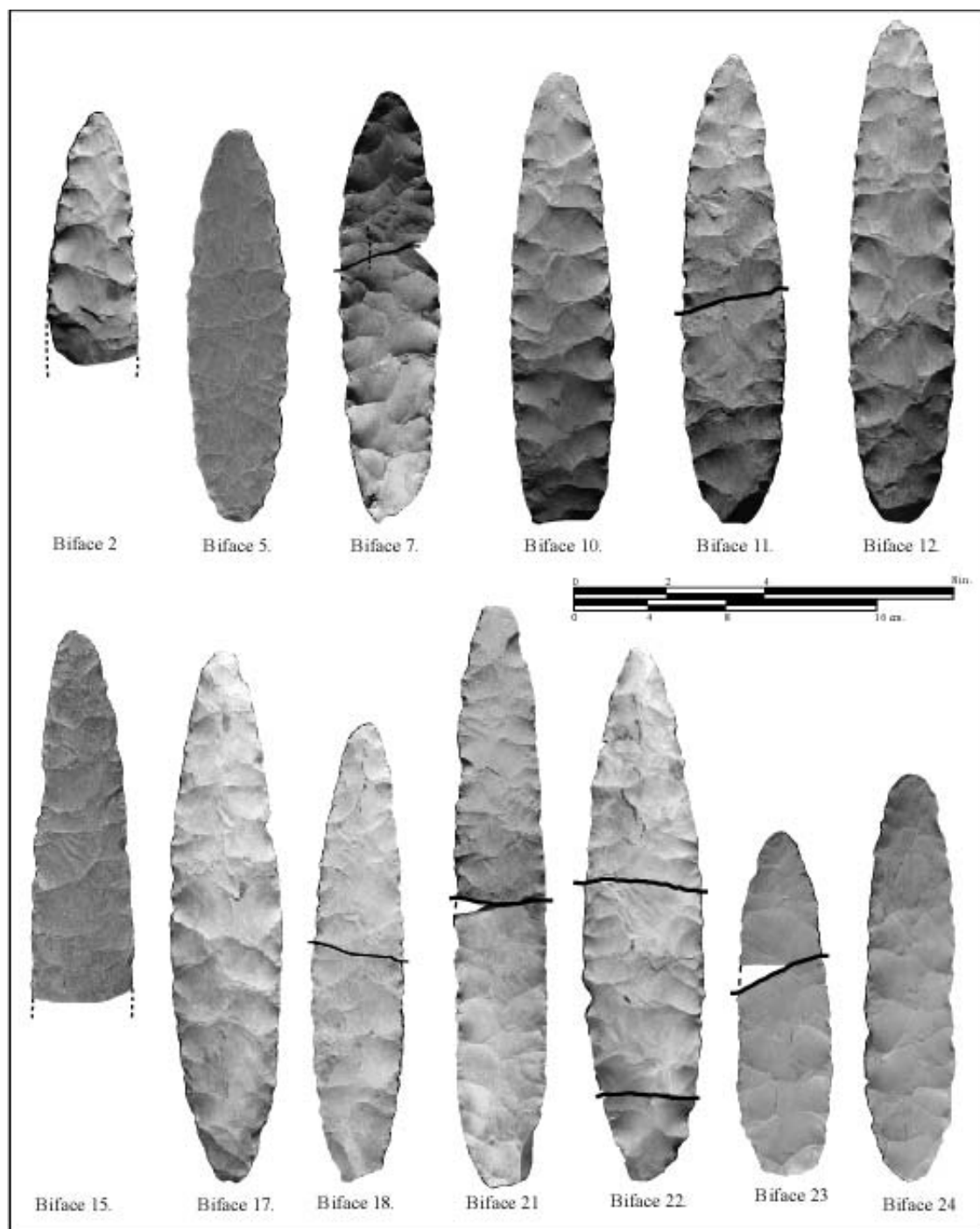


Figure 11. Group 1 Bifaces

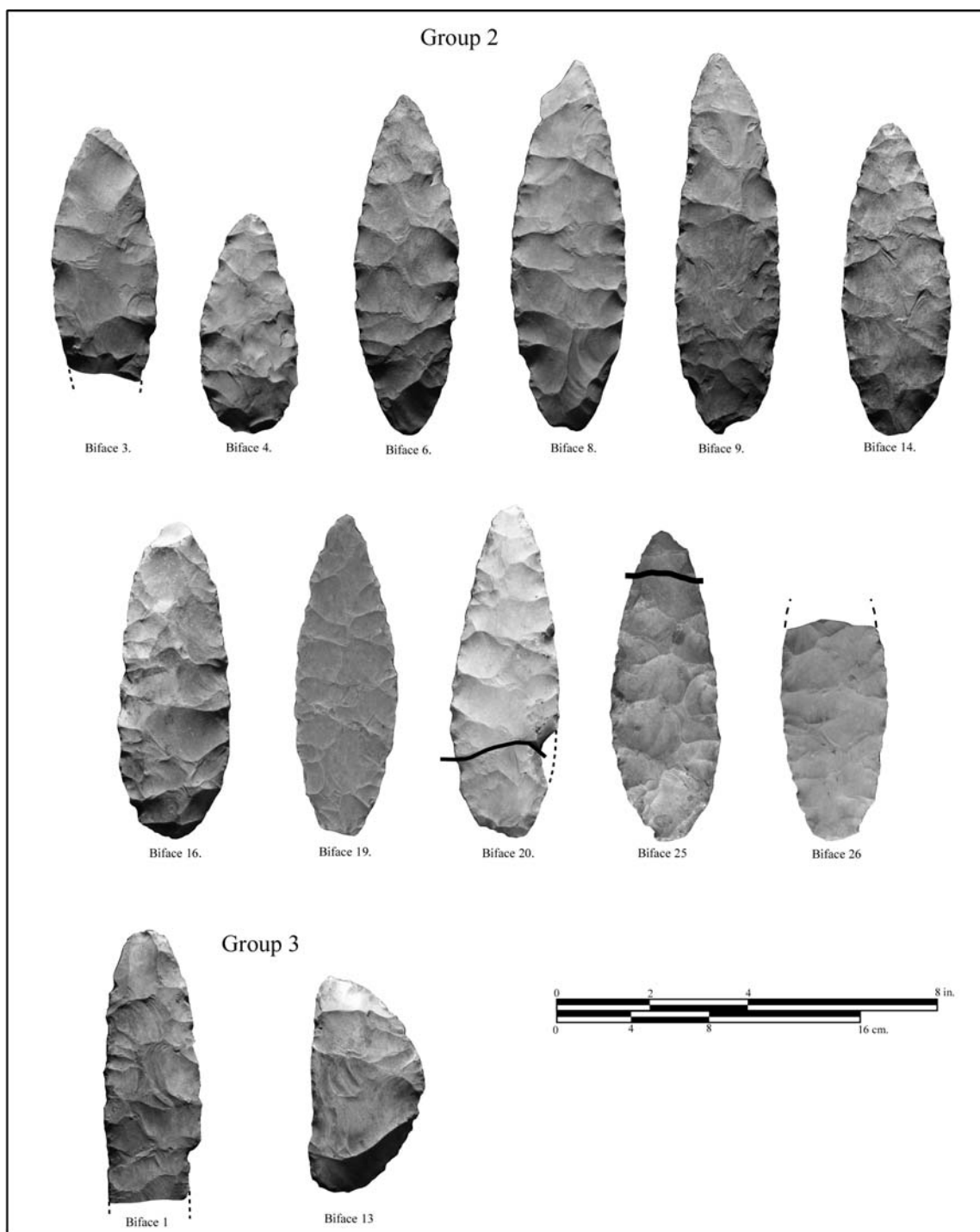


Figure 12. Groups 2 and 3 Bifaces

respect to size and there is no observable spatial distribution across the site because the bifaces were collected before precise provenance was established on the site.

### Reduction Stage

Technological description of the cache involved examining the flaking patterns with reference to previous research and models proposed and utilized by Young and Bonnicksen (1984 and 1985), Bradley and Stanford (1987), and Callahan (1979). Like many other experimental studies, each of the research strategies examined attempts to understand the mechanics of reducing a raw material to a serviceable tool and explaining what is observed in the archaeological record, but each addresses the tool production from unique aspects that, when combined, provide a more holistic model. Additionally, all three studies focus on large lanceolate point production most similar to the types of bifaces found in the Hegar Cache.

Young and Bonnicksen observe and categorize the processes modern craftsmen used in knapping tools as "... living model of the relations among cognition, behavior, and material products" (Young and Bonnicksen 1985:92). Their observations are categorized as emic goals and behaviors which are applied to observed flaking patterns on the Anzick and Moosehorn fluted point caches. Their experiments result in a flake scar morphology key that associates observable flake scars with a technology to remove the flake and a production sequence that describes the general stages of tool creation from obtaining the initial raw material to finishing the tool for use. The flake scar morphology key (Young and Bonnicksen 1984:104 and 1985:107) links the observed

reduction techniques with identifiable flake scars on the experimental points. The Young and Bonnicksen production sequence divides the sequence into 4 stages (Young and Bonnicksen 1984:34 and 1985:96):

- |                         |   |
|-------------------------|---|
| 1. Core Work            | Remove a suitable flake from a core                         |
| 2. Edge Preparation     | Center and strengthen the edge and create a regular outline |
| 3. Shaping and Thinning | Obtain the desired shape, size, and thickness               |
| 4. Finishing            | Improve appearance and effectiveness as well as notching    |

Bradley and Stanford (1987) analyze square-based, non-squared-based bifaces and Cody Complex projectile points from the Horner Site. They compare the artifacts to experimental tools to understand the reduction system. Experiments include documenting the production of Eden points from obtaining raw material to finished projectile point. Their goal is to understand the technological aspects in producing projectile points. The reduction strategy include seven documented steps; however, as noted, a serviceable projectile may only require the first four steps and preparation of a stem:

1. Selection of flake from raw material
2. Biface preparation with selective flaking to create even lenticular lateral cross-section, parallel sides, and a convex to flat base
3. Preform creation with selective pressure flaking to create regular surface minus step fractures and convergent tip and straight base
4. Preform refinement with serial pressure flaking of each face and margin. This stage required up to four tries of serial comendial flaking to get pronounced median ridge and maintain regular parallel flaking scars.
5. Reapplication of Stage 4 to refine parallel flakes.
6. Reapplication of Stage 4 to refine parallel flakes.
7. Reapplication of Stage 4 to refine parallel flakes. Reapplications terminated when desired form was achieved.

The stages illustrated in Figure A2.7 (Bradley and Stanford 1987:415) aid in identifying flaking patters associated with each stage. A step discussed but not added into the staged process was the final stemming through margin grinding or indentation. Their experiments illustrate the apparent reduction in width, minimal reduction of tool thickness, and maintenance of the tool length; but, unlike Young and Bonnicksen (1985), Bradley and Stanford both include additional stages to achieve a specific flaking pattern and exclude stem preparation. Bradley and Stanford (1987:415) also examine the change in dimensions of an item as it progresses through the stages.

Callahan describes experimental recreation of Clovis points to show both similarities in early stages of production and differences in later stages of production in Virginia. Experiments include knapping bifaces in 1000 experiments for comparison to Williamson and Flint Run sites. Callahan attributes much of his development of stages to Muto (1971:28-31) who refers to Sharrock (1966). Like the other models, Callahan describes the reduction of a material to a projectile point in five stages (Callahan 1979:10):

- |                       |   |
|-----------------------|---|
| 1. Obtain the blank   | Either utilize a cobble or remove a useable flake   |
| 2. Initial edging     | Lenticular cross-section, center edges, edge angles 55-75 deg, remove projections from faces  |
| 3. Primary Thinning   | Lenticular cross-section, centered edge angles 40-60 deg., width/thickness ratio between 3.0 and 4.0. Flake scars meet at the midline.  |
| 4. Secondary Thinning | Flatten cross-section with a width/thickness ratio more than 4.0, centered edge-angles between 25 and 45 deg. Flakes cross the mid line. Prepare edges for hafting, notching, or fluting. |
| 5. Shaping            | Shaping the outline in preparation for hafting or fluting which may require four additional stages.   |

These descriptions are accompanied by sketches in Table 1 (Callahan 1979:10) and a table of width/thickness ratios (Callahan 1979:18 Table 5) which can be used visually as well as mathematically to aid in classifying stages.

All three models work on various aspects of large lanceolate point production but with different emphasis in experimentation. Young and Bonnicksen (1985) evaluate the process of making stone tools in terms of “problems” that a craftsman of any time must overcome when using prehistoric techniques. Documentation revolves around the through process to achieve the desired goal. The strength of their experiments is that it provides the potential decisions behind individual stages although the stages they describe are the most general of the three models examined. Bradley and Stanford (1987) complete production of a single point type (Eden) with very specific attributes: lanceolate, narrow parallel flaking, and basal preparation. Their experiments emphasize morphological changes between the stages and illustrate the diversity of tool “types” accessible from a single reduction sequence in the archaeological record at the Claypool site. Their extension of the experiment to create a specific tool provides a clear example of the amount of work necessary to achieve a specific shape (Bradley and Stanford 1987:416). Callahan examines variation in the process of point production by documenting different knapping techniques and tools on a variety of materials. Callahan’s extensive illustration and wide range of materials and flaking technology are an excellent example of documenting experimental tool reproduction; however, there is only brief discussion of the choices and decisions made in the reduction sequence. Comparing the stages of production in all three models reveals the initial three stages are



very similar with the variation in later stages being dependent on the individual researchers goals (Table 7).

Table 7. Comparison of models

Stage	Young and Bonnichsen (1985:96)	Bradley and Stanford (1987:412-417)	Callahan (1979:10)
1	Core Work	Select material	Obtain the blank
2	Edge Preparation	Biface preparation	Initial edging
3	Shaping and Thinning	Preform creation	Primary Thinning
4	Finishing	Preform refinement	Secondary Thinning
5	-	Reapplication of 4	Shaping
6	-	Reapplication of 4	-
7	-	Reapplication of 4	-
8	-	Grinding or Notching	-

In applying the Young and Bonnichsen (1985) model to Hegar cache, the edges are centered, strengthened and a regular outline created; but, instead of leaving a straight, continuous, strong edge, some thinning flakes were removed leaving a sinuous edge in preparation of further shaping/thinning. The steep edge angle leaves a strong edge making the Hegar cache deposit in the early to middle of Stage 3. Following Bradley and Stanford (1987) the Hegar cache bifaces are given a lenticular lateral cross-section, roughly parallel sides. There are also few to no hinge or step fractures and convergent tip/base similar to Stage 3. Most flake scars on Hegar bifaces are uniform in size but no obvious narrow serial flaking is evident in the form of standard flakes side by side meeting at the midline as described in Stage 4. Employing the Callahan (1979) stages,

the Hegar cache bifaces have lenticular cross-section with centered edge angles between 40 and 60 degrees and width/thickness ratios predominantly between 3.0 and 4.0 similar to Stage 3, but upon examination of the drawings in Callahan (1979:155 Figure 67), the Hegar bifaces are more similar to Stage 5 Shaping/Refined preform.

Therefore, as described in the three models, the Hegar cache bifaces were stored at the point in the reduction stage after the edges are centered but the steep edge angles still dominate. Further thinning and more refined outlines are initiated leaving a continuation of the process needed after recovery of the items. More thinning is anticipated, but the bifaces retained a strong edge and thick cross-section preferable to maintain their large size for either travel or storage before shaping into finished tools.

Whether the cache is intended for later use, trade, or the bifaces are part of a burial, their general shape and the stage of reduction suggest they are intended to be complete tools upon further reduction. The caching craftsman performed the initial reduction and arranged the subsequent thinning while the final thinning and basal preparation is to be performed by the beneficiary. Because most archaeological projectile point/knife typologies are based on stem or base preparation, it is difficult to determine which type of tool would result from the reduction of the bifaces; however, the overall long and leaf-shapes of the bifaces suggest a long and narrow knife or point type was the planned end product.

## Typology

Major typological features, e.g., basic reduction strategies and overall point morphology are cultural standards (Bradley and Standford 1987:411-412); therefore, the size, shape and material should aid in establishing a cultural association. The large size, lanceolate shape, and “exotic” material are more common in Paleoindian and Archaic point types. Long and narrow leaf-shaped points of these periods in Texas are limited to Angostura as a variety of the Agate Basin type. Angostura points have a “slender leaf shaped point” with “oblique parallel-flaking” and a “narrower base than lanceolate forms” with great diversity and can be found throughout the eastern two-thirds of Texas (Suhm and Jelks 1962:167; Turner and Hester 1985:66; Justice 1987:33; Perino 1985:15) and were initially separated from Agate Basin by Hughes (1949) as the “Long Point”. Justice (1987:33) cites three sources that consider Angostura a variety of Agate Basin that has concave basal edges and oblique parallel flaking. Agate Basin are lanceolate with parallel or slightly convex edges and straight, concave or convex bases with grinding and horizontal flaking (Justice 1987:33; Perino 1985:5). Of the illustrations in Plate 1 (Perino 1971:2), only one has a convex base, three have flat and two are concave. According to Perino (1985:15) and Justice (1987:33) the Agate Basin cultural complex begins around 10,500 and 10,000 B.P. and extends to roughly 9400 B.P..

In Texas, Angostura is found on sites dating between 8500 and 8000 B.P. (Turner and Hester 1985:66). Specimen photographed in Suhm and Jelks have flat to slightly convex or concave bases with the widest point between one-thirds and two-

thirds the length of the point (Suhm and Jelks 1962:Plate 84) while Turner and Hester's illustrations show three with flat to concave bases and basal edge grinding (Turner and Hester 1985:66-67). More recently, the Angostura type as described by Bousman and others (2004:22) recognizes the wide variety in overall shape and size but distinguishes Angostura by the diagonal flaking pattern. Relying on the final flaking pattern to identify the type makes identifying the perform or blank needed to produce these points difficult. Dockall and Pevny (2005:175) describe the Angostura assemblage from the Richard Beene site (41BX831) as possibly "... the largest assemblage of cultural material associated with Angostura projectile points in Texas." The bifaces associated with the Angostura points were considered *Lerma* bifaces (Turner and Hester 1999:145) and described as large knives (Dockall and Pevny 2005:190). The one complete specimen illustrated is roughly 150mm long and 30 mm wide with roughly parallel sides most similar to the Hegar Group 1 bifaces.

The dimensions of Angostura range from 50 to 100 mm long, 18 to 42 mm wide, and 12 to 18 mm thick (Suhm and Jelks 1962:167) roughly 112 mm shorter and 10 mm narrower on average than the Hegar bifaces. To reduce the Hegar bifaces from Stage 3 bifaces following the model of Bradley and Stanford (1987:414 Table A2.1) and Stage 4 bifaces following the model Callahan (1979:154 Figure 66) to Angostura points described in Turner and Hester (1985) and Suhm and Jelks (1962), would require reducing the length and width by 65 and 45 percent respectively on average. The Hegar cache biface thickness is equal to the described proportion in the Texas resources. These ratios are significantly more than the 4% length, 39% width, and 8% thickness measured

in either the Bradley and Stanford or the Callahan study to reduce the experimental bifaces from Stage 3 to finished projectile points.

## Microwear

Micro-wear examination of the bifaces focuses on inventorying the location, kinds and intensity of wear by using a variety of magnifications then combining these three categories of information to discuss patterns of wear. Answering these basic questions is the focus of practically every recent archaeological and experimental micro-wear study but finding a consensus has proven difficult among researchers. Following the pioneering work of Semenov (1964) and White (1968), the standardization of terms and definitions as well as the use of experimentation was called for by Hayden and Kamminga (1973), Keeley (1974), and Odell (1974) to make the information from earlier and future studies comparable. Although studies continue to use a variety of definitions and degree of wear intensity, the accuracy in identifying use and material at high-power by Keeley and Newcommer (1977) and at low-power by Odell and Odell-Vereecken (1980) was an affirmation of micro-wear analysis as a valid contribution to archaeological investigations. Detailed overviews of use-wear studies is well documented in Grace (1989; 1996) and Odell (2001:50-56) while examples of detailed studies in fracture and breakage micro-wear include Dockall (1997), studies in polish formation include Grace (1985) and Levi-Sala (1996) and micro-wear examination of Paleoindian and earlier artifacts include the work of Kay (1996:126-146), Kay in Hardy (2001:10972-10977) and Donahue *et al.* (2002:155-163).

Like the current investigation, most recent studies document the location, kinds and intensity of wear by using a variety of magnifications then produce interpretations of those patterns. Unfortunately, the history of the bifaces since discovery includes one sitting on the dashboard of the landowner's pickup for several years prior to discovering the major part of the cache. The remaining bifaces were excavated with a box blade followed by either remaining on the surface until rain and cattle trampling exposed them or they were transported to a barn in a backhoe bucket, and finally redeposit and packed into a floor surface. All of this occurred after burial in Boy loamy fine sand (NRCS 2005) with highly acidic, fine-grain quartz sand with abundant water, rodent, and colluvially moving soil. The extensive weathering, as noted in the material identification by Banks (2006 personal communication), altered most of the biface sample surfaces to such an extent to hide most of the lithic material attributes. This heavy post depositional wear limits the micro-wear examination. In an experimental study of post-depositional wear, Levi-Sala cites Keeley (1980:29) in stating polish studies are unreliable on patinated flint (1996:17) as artifact movement in soil promotes the development of sheen and edge damage Levi-Sala (1986:231). Levi-Sala's 1996 experiments included tumbling flaked fine-grain chert in a polishing kit at 60 rpm with wet gravely sand similar to the E2/Bt horizon contact in the Boy soil series description on the Hegar environment. The experimental chert develops a sheen and erased striations (Levi-Sala 1996:52). Of note in the Levi-Sala study that is relevant to the Hegar site environment and micro-wear analysis; wet environments soften chert

materials, abrasives wear flaked materials from the edges and arrises inward toward the interior of flake scars (1996:68), and moving sandy soils often remove residues (1996:51).

Despite the post-depositional and post-recovery wear, each biface is examined microscopically for evidence of use-wear although none of the bifaces had a straight, refined edge typical of a cutting or scraping tool. Each biface is subjected to an ultrasonic cleaning in distilled water to remove soil matrix and methyl alcohol to remove oils. An initial survey of each bifaces is conducted using low power, 8X to 100X, to find areas with rounding/smoothing of the edges, polishes, extensive hinge/step fractures, and residues similar to those defined by Vaughan (1985) and Ahler (1979). Intensity of the wear followed Ahler (1979:316) with 70X magnification to identify light wear, 40X magnification to see moderate wear, and no magnification to identify predominate wear. High power examination, 100X to 500X, is restricted to those areas with the greatest amount of wear discovered in the low power examination to aid in identifying the type of wear. High power examination is to provided additional detail such as identifying types of polish, direction of wear and superposition of types of wear as called for in Kay (1996:317). Wear location is documented on macroscopic photographs of each biface and corresponding notes were made of intensity.

The examination found light to heavy amount of patination on all of the bifaces. Over half of the bifaces exhibit moderate to strong patination over a significant portion of the surface while the remaining bifaces have light to moderate amounts of patination along arrises. Light to moderate amounts of rounding and smoothing attributed to

patination is found along biface edges and flake arrises on all bifaces. Polishes on top of patination are observed on 18/22 (81%) of the bifaces in isolated areas along arrises 12/22 (55%) and in flake scars 3/22 (14%). Residues from the box blade are found on 14/22 (64%). Biface 5 (Figure 13) provides examples of both the moderate post depositional wear and polishes. Combined, the amount and placement of the wear patterns observed microscopically is indicative of a progression of patination across the surface of the bifaces. Polishes in flake scars, e.g., Figure 13, are similar to the “bright spots” described in Levi-Sala (1996:70) as flat areas produced by rubbing two similar materials together in a wet environment.

### Summary

The Hegar cache includes 20 whole and 6 broken lanceolate bifaces made of Edwards chert. Metric data is collected and morphological comparisons with three reduction models associated the bifaces with a reduction stage and cultural affiliation. A low power micro-wear survey and high power micro-wear examination of select targets is also conducted to aid in understanding what, if any, use-wear the bifaces may contain before caching.

Morphologically, the cache includes large, lanceolate-shaped, bifaces with uniform thickness. Flake scars generally terminate near the centerline, but few have a well developed central ridge. Biface edges are generally sinuous with steep angles as they are dominated by alternating thinning flake scars on opposite faces and abraded or roughen edges to create a durable surface for additional thinning and shaping flake



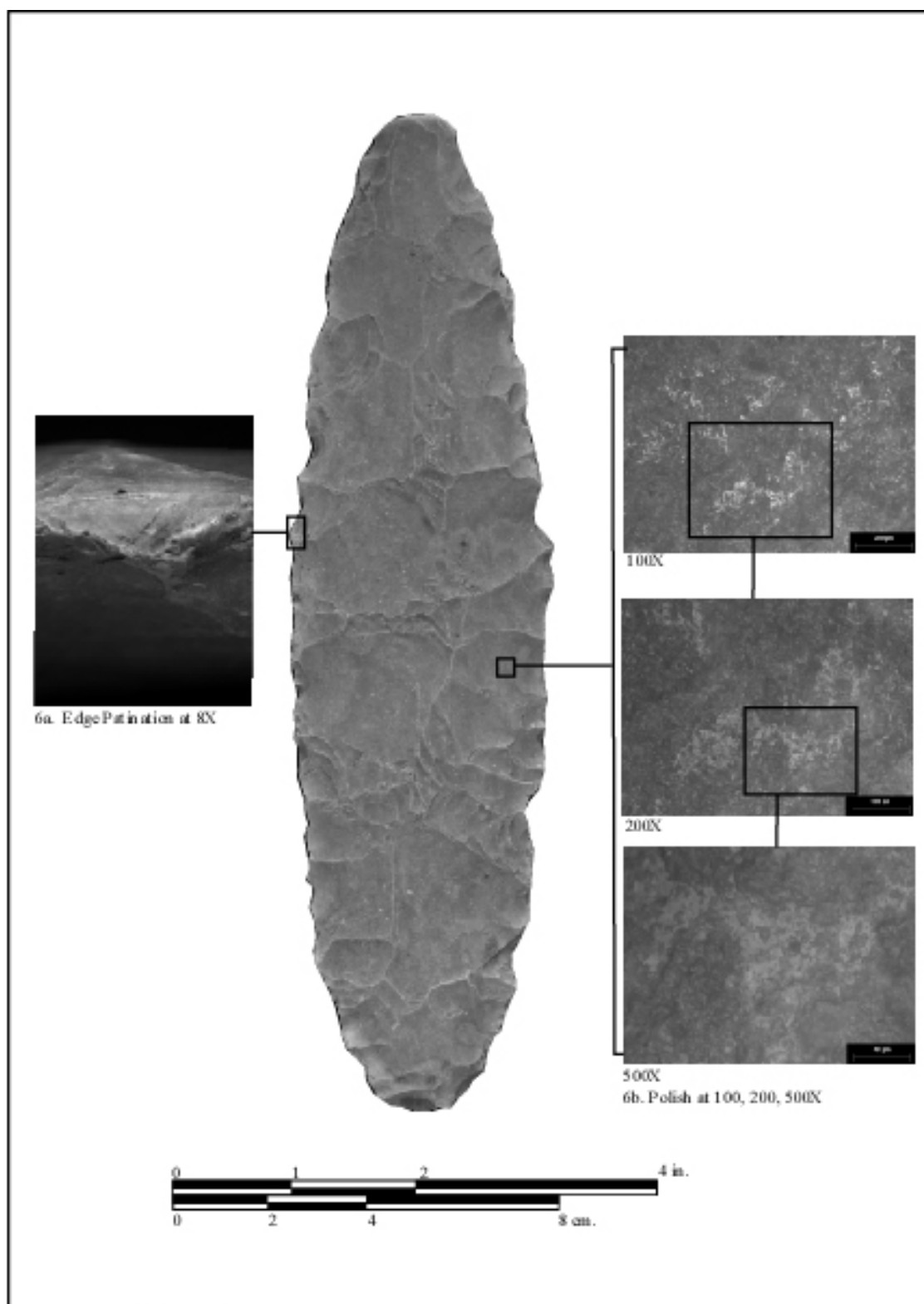


Figure 13. Biface 5 Microwear

removals. The bifaces are divided into three groups: 1) with indistinct tips and bases, parallel to slightly convex edges, and a generally long narrow outline; 2) with more clearly defined tips and bases, distinct convex edges, and generally shorter and wider outline; 3) reworked biface fragments. Comparison of the bifaces to three experimental reduction models reveal that the artifacts are cached after the edges were centered but the steep edge angles were still dominate thereby retained a strong edge and thick cross-section ideal for storage or travel. This stage of reduction also allows the recipient of the bifaces flexibility in deciding the final shape and flaking pattern.

Typologically, the Hegar bifaces are most similar to Angostura projectile points based on similarities in the ratios of length, width, and thickness; however, because the bifaces are from an early reduction stage and significantly larger than finished Angostura points, it is not possible to clearly associate the bifaces with Angostura type.

The micro-wear investigation focused on documenting the location, kind, and intensity of wear. The depositional environment (Boy Series soils with quartz sand, high acid, abundant water) and history of the bifaces since discovery (mechanical excavation and re-deposition in a dirt floor) make any prehistoric use-wear study impractical. Rounding/smoothing and polishes observed on the bifaces are attributed to post depositional wear while residues were attributed to the history of the bifaces since discovery.

## CHAPTER IV

### CACHING BEHAVIOR

Following the definition of lithic cache in the Introduction as hidden lithic material intended for later use, caching primarily minimizes stress (Torrance 1983) and risk associated with seasonal movements of mobile populations (Winterhalder 1997) in earlier highly mobile populations. Lithic caching may also be part of a trade system, a boundary demarcation, or serve a ritualistic function, but these caching situations are difficult to prove categorically without historic documentation as a “successful” cache will be utilized and no physical evidence will remain for the archaeological record. Storing stone tools for a future need; however, can include one or several of the following cognitive functions:

- 1) The individual sees a personal interest in returning to the cache to retrieve a commodity at a future time. By storing material, the individual is almost assured to benefit from this behavior when it is necessary. This suggests some predictability of returning to the location even if the individual creating the cache expects others to collect the original material and deposit new material in a delayed exchange (Jochim 1981:177). Jochim (1981) cites Heider (1969) defining a delayed exchange as a two way transfers of goods separated by some time lag. An exchange requires two conditions: the individuals or groups are codependent, and they may not have the same shortage at the same time (Jochim 1981:177). Caching material for ones own use suggests the caching occurring well within the territory or route of the initial depositor;

however, as a delayed exchange, caching should occur on territorial or migratory boundaries of specialists to benefit from the surplus of adjacent populations with different surpluses. For example, groups living near quarries exchanging stone for an equal valued resources from a neighboring population at some intermediate point between the two group territories.

2) The individual has no need for the cached items until returning to the location. A cost-analysis by the individual suggests the destination has the necessary material to subsist. This is logical when seasonal resources are well known. The individual is scheduling resources availability based on the natural distribution, frequency, and scale of the material (Kuhn 1994:428). This is most similar to Binford's generalist model of subsistence (Binford 1980).

3) There is a need for the material when the individual returns and there will be enough to satisfy that need. Jochim (1981:165) discusses this as an anticipatory strategy. The individual decides where and how much to cache for the return. Collins (1999:176) cites Binford (1979) with caching as "passive" material not need until the same time and location next year. Cached items are needed to harvest particular seasonal resources, for example, migratory birds or fish, which may require special equipment not need at other times. This rational is most applicable to the generalist who is traveling to harvest specific resources at a known patch.

4) Caches include items that are scarce in the vicinity. As abundance of the material declines, caching becomes essential to insure the material is available for use upon return to the location before revisiting the initial patch. In terms of lithic material,

the individual is traveling away from the quarry and will be returning along the same route. This strategy anticipates or responds to an imbalance in the distribution of the resource (Jochim 1981:164). With lithic material, the further from the quarry, the more crucial and valuable the material becomes, especially for a specialist who is depending on a limited variety of resources. Collins (1999:176) discusses this type of caching as insurance what may be needed in the future.

These cognitive functions of caching can overlap significantly, e.g., an individual can cache a significant quantity of items that may be taken and replaced by similar items that serve the same function by other individuals who share a need to harvest a specific geographically located resource or serve another cultural need. With a multitude of reasons to cache items, the cache context and the cache content can aid in deciding the cache purpose.

#### Provisioning A Place For Future Need

"Caching eases the scheduling contrast that result from the spatial and/or temporal disjunction of lithic availability and communal subsistence activities" (Seeman 1994:284). Seeman's statement identifies caching as an individual or group provisioning a place for future need. Countering predicted stress associated with subsistence is the function Optimal Foraging Theory (OFT). In an optimal foraging model, caching is a decision to create a resource patch with a known quantity to be exploited at predicted time in the future. Caching is a more efficient means of obtaining a resource in the quantity needed at or near the desired location hence increasing

productivity of other, less predictable, resources. These more efficient devices increase hunting productivity instead of reducing the time spent hunting (Jochim 1981:122).

Optimal foraging is the result of a cost-benefit analysis by the individual or group (Kaplan and Hill 1992) and includes three assumptions: 1) the individual will make a decision between prey and patch choice; 2) currency in terms of long-term, average-rate, or maximization of the resource; and 3) sequential or random search for the prey or patch and exploitation of the resource (Stephens and Krebs 1986:11). Essentially, which resource will be used, will the resource be completely exhausted or rationed, and will obtaining the resource rely on a systematic use or be randomly consumed.

While fault has been described with this approach as inadequate because it discounts culture (Bernbeck 1991:48 and Milne 1993:321), this theory focuses on humans in an “open access” system most similar to Hunting/Gathering societies. Applying OFT to lithic caches, the individual will choose whether or not to exploit a cache, whether or not to use all of the material in the cache, and in what order, sequentially or randomly, a set of caches should be exploited. Logically, natural selection will favor those individuals or groups who are more efficient in their use of energy in acquiring and processing resources (Kaplan and Hill 1992:168). Gerber *et al.* (2003) cited Winterhalder (1981) in stating that foragers ideally consume the most profitable resources then redirect their attention to less and less profitable resources. Therefore, caches should be exploited only when necessary, at the minimum rate and amount necessary, and the cache should be exploited sequentially. Unfortunately, the only caches found archeologically are those that were lost and that contained material that would endure extended burial.

Gerber, Reichman, and Roughgarden (2003) believe it is possible to develop a simple prey selection model to predict optimal foraging and food storing behavior for one prey type that varies in quality between two time periods. They concluded that caching becomes optimal when the abundance of a resource declines and the value increases over time (Gerber *et al.* 2003:83). In applying this model to prehistoric human lithic tools, it should include the costs of technological production and transportation of tools and materials (Bousman 1993) with these populations consuming most profitable resource first. At some point, the activity costs more than it provides and a new resource (cache) must be exploited or a new technology must be adapted. Resource and technologies that require significant energy and time in production promote a level of specialization and more specific resources (Bousman 1993). Specialization, in turn, is behavior that prefers a narrow range of subsistence activities hence limiting the variety of resources chosen.

Specialization promotes either a technology or environment that allows for a sedentary life style or specialization promotes the need for a nomadic lifestyle following select resources. With sparse populations and without the technology for cultivation or livestock domestication, early prehistoric cultures relied on the existing nomadic traditions. A nomadic lifestyle requires following specific mobile resource, for example, migrating animals, or altering resources to allow temporarily unused resources to replenish naturally. Caches in an isolated context are associated with Paleoindian/Early Archaic resource scheduling to offset shortages in specific environments (Binford 1980:12) in an Optimal Foraging model.

Binford (1979:270) summarized caching as a means of distributing gear to increase utility. Optimal foraging suggests a mobile population will either generalize adapting to a wide range of resources that significantly overlap in providing the necessary substance, or a mobile population will specialize in a resource that will endure continuous harvesting. In an optimal foraging model, caching is a decision to make a resource patch with a known quantity to be exploited at predicted time in the future. The decisions about when to leave the cache, what and how much to cache, where to leave the cache, and when to retrieve the cache are the result of a cost-benefit analysis of by the individual. Creating a cache (patch) makes the likelihood of success in other activities considerably higher. Knowing what and how much is in the patch minimizes the time and effort in the patch and increases productivity in other activities. The energy used in creating and harvesting a cache includes making the tools, transporting them to the location, burying them, and relocating the cache when needed. Caches for provisioning a place for future need vary in the archaeological literature from caches with a large number of early stage items, such as blades or bifaces, which can be made into a variety of tools and match the expected need to caches with a variety of tools with varying amounts of use wear. Caching is a very effective optimal foraging strategy for mobile populations as a majority of the costs are incurred before the stress of needing tools is apparent.



## Banking/Insurance Caching

Banking/insurance caching is similar to provisioning a place for future need as the stress of obtaining the material occurs before the need, but the need is neither apparent nor predicted. Unlike “passive gear” which includes seasonal items (Binford 1979:256-7), banking/insurance caching provides security but is not utilized unless needed. Cached items are often stored in isolated context near distinctive landmarks (Miller 1993: 13; Rathje and Schiffer 1982; Button 1989:216; Scott *et al.* 1986:15) or near stream crossings, off site, or rock crevasses in a general area with the goal of aiding in an unexpected need at an unknown time in the future (Binford 1979:257). Following Binford’s observations in Alaska, these caches can include items for general survival and not a specific task. In addition, these caches are open to anyone who needs them. Transferring the knowledge of where the cache is located is done through personal connection with others who conduct the same activities; suggesting the caches are in easy to find locations, they contain basic survival items, and the information can be traded to establish or maintain working relationships between individuals or groups.

Banking/insurance caching is similar to mountain huts that dot the Rockies and Alps; the door is unlocked and anyone can spend the night. There is generally little to no food, but visitors to the huts often leave unused fuel or other items in a continuous and self-generating storage for themselves and anyone else who visits the hut. Knowing the location of the huts can be part of a scheduled stop or life-saving information in an emergency.

## Trade Caching

Trade caching includes the storage of goods for the purpose of retrieving them at a later time for trade (Miller 1993:11; Scott *et al.* 1986:15) or storing the goods for someone else to recover and leave an equal value of desired items in a delayed exchange (Jochim 1981:177). In a regional territorial setting withholding or sharing the location of a cache can also be used by one group to manipulate another or by one group to gain independence from the other (Kornfeld *et al.* 1990:302), although control caching is most effective with items needed on a frequent and regular basis that cannot be substituted or the cached items have a status, ceremonial, or ritualistic purpose.

Unlike caching to provision a place of need or banking/insurance which may include a variety of tools, caching for trade assumes the items are at a basic stage of reduction or, at least, unused and include a larger number of similar items. Miller (1993:40) described trade caches as including large, early reduction stage bifaces to both minimize transportation cost and serve as the basis for a variety of tools. Another indicator of a trade cache is the cache being placed in a location distant from the cached raw material source but in an area where other material that would meet the same technological need and is abundant. The location of trade caches are typically along territorial boundaries and may act as boundary markers (Miller 1993: 13-14; Button 1989:216) and occurs most prominently during the Archaic between 8000 to 3500 B.P. according to Johnson and Goode (1994) and Collins (1995).

Caching as a delayed exchange focuses on a two way transfers of goods separated by some time lag requiring the individuals or groups are codependent, and

they may not have the same shortage at the same time (Jochim 1981:177). Caches also represent a fixed location with, more or less, stable quantities that can act as a damper on instabilities of perishable or seasonal resources. Focusing efforts on unstable resources promotes specialization in an effort to reduce costs associated with acquisition, processing, and dividing time among several different task (Jochim 1981:137). Regional territories and specialization are indicative of Archaic populations as Paleoindian populations are considered widely dispersed groups with infrequent contact (Story *et al.* 1990:425). Through increased population Archaic territorial boundaries became increasingly rigid and exchange became increasingly important (Walthall and Koldhoff 1998:258). Finding a cache archaeologically may represent a failed exchange system as neighbors broke relationships and became hostile. Abandoning friendly relationships may mean the end of all exchanging to include individuals for marriage and mark the beginning of open hostilities as recorded by Cabeza de Vaca between 1528 and 1536 of the Coahuiltecan of the Rio Grande Valley (Walthall and Koldhoff 1998:269).

To summarize, trade caching represents a safe location between transport in isolated context near a territorial boundary. Further evidence of trade would be a cache in a location where technologically equal quality material is abundant. Trade caching should be most prevalent when territorial boundaries are firmly established and there is a mutual reliance specialized resources outside the group territory. Trade caches include large quantities of basic forms ready for refinement and have minimal to no use-wear. As either delayed exchange or a territorial marker, caching should occur on territorial boundaries of specialists to benefit from adjacent populations with different surpluses.

These items may be either profane, subsistence items intended for use, or sacred objects that enforce alliances and social networks (Walthall and Koldhoff 1998:268).

### Ritualistic Caching

Schiffer (1987:79-80) described ritual caching as discrete concentrations of complete artifacts produced in a ritual context. Similarly, burials would be the ritual discard of bodies often associated with items that are not intended for retrieval, but like offering or votive caches placement is in a special location, e.g. trail shrines, which are visited at regular intervals (Schiffer 1987:79-80). Burials and votive offerings are often included in the term “cache”; however, contrary to caches, burials and votive offerings often include implements, ornaments, and exotic artifacts (Bement 1991; Taylor and Highley 1993) arranged around a body, in the case of a burial, and are not removed once deposited. Therefore, burial “caches” are not caches as they are not stores for a future use by the living. Unfortunately, beyond clearly identifying ornaments and exotic artifacts or the association with grave or shrine features, there is little to distinguish caches from burials and votive offerings especially if ritualistic objects are cached as part of a trade.

In examining large Dalton blades, Walthall and Koldhoff (1998) illustrated how ritual biface trade occurred as early as the late Paleoindian period. These items are "Primitive valuables" (non-utilitarian material goods) according to Dalton (1977:197-200) and include trade of ritual items in delayed reciprocity to insure peaceful relationships. Walthall and Koldhoff (1998:259) cite Luedtke (1976:320) that trade of

sacred items would include rare, finished form, unusual size, unusual shape items with fine workmanship from labor or skill intensive production. Additionally, they would have a non-utilitarian function with extremely large size and dysfunctional features (Brown 1976:148), be highly portable forms, durable materials, and unusual quality of material for the area situations (Johnson 1986; Campbell and Campbell 1981:26-27) and be found in graves, caches, or other special context (Luedtke 1976:320). Their function would be as ritual items with inherent “power” (Walthall and Koldhoff 1998:258-9).

Large, unusual shaped items made of high-quality material in a cache may indicate a territorial boundary near a location where neighboring populations would meet regularly and exchange items other than the cached material. Both Walthall and Koldhoff (1998) and Scott *et al.* (1986) cite Hughes (1978) ethnographic examples from northern California of cached bifaces that were stored in isolated locations known only to the individual and occasionally excavated for display either in the hand or hung from a cord to show personal status and connection with neighboring groups. In this instance, cached items would serve as a boundary marker, a connection between groups, and a status symbol. The death of the caching individual would mean the loss of the cached items and possibly the loss of an exchange partner.

## Summary

Caches can represent several cognitive functions that revolve around having the material and or items in sufficient quantity to satisfy either a predictable need or as

security in an unknown situation. The cognitive functions include provisioning a place for future need, banking/insurance, trade, and ritualistic purposes.

Provisioning a place for future need includes preparing for a spatial or temporal gap in the needed material. The maker of the cache decides when, how much, and which cache should be exploited based on production and transportation costs to maximize profit. The provisioning a place for future need is an effective strategy of mobile populations similar to Paleoindians or early Archaic populations with a large territory as the costs are incurred before the stress is evident. Sites with provisioning caches should be on or near large sites with repeated use as part of a seasonal movement.

Banking/insurance caching is a means of preparing for an unanticipated event. The cache includes general items for survival and not task specific tools or raw materials. Banking/insurance caches are in easy to locate places near a predicted hardship, e.g., a river crossing. Knowledge of the cache location can be shared with others as a way of maintaining relationships.

Trade caching includes both storing raw materials or manufactured items for a trade or placing the items in an agreed location for a silent trade. Trade caches should include a large number of similar items in either basic reduction stages or in refined stages manufactured by a craftsman. These caches should occur near territorial boundaries and would be more abundant as population density increased.

Ritualistic caching is the storage of items that are often rare, finished form, unusual size with labor or skill intensive production and not serve a utilitarian function. Cached items may be recovered for ceremonial or status displays .

## CHAPTER V

### CONCLUSIONS

A lithic cache, as often described as a cluster of several items of “early” form items, e.g., blanks, blades, raw material cobbles, that can be reworked into a variety of items (Green 1963:150 and Tunnel 1978) or an assemblage of items typical of a task (similar to the Lembke cache described by Walthal and Holley 1997). These items are typically closely arranged in a small pit feature and recovered at a later time as needed. The discovery and excavation of 26 large (119 to 321 mm long) lanceolate or leaf-shaped bifaces with poorly defined tips and bases bifaces in isolated context is a snapshot of what was important on a material and ideological level to prehistoric populations in the area. In behavioral terms, the Hegar cache represents provisioning a place for future need, banking/insurance, trade, or ritualistic needs. Deciding which behaviors are represented in the Hegar cache required excavation to understand the site formation processes, artifact distribution, and search for features followed by an analysis of the biface’s morphological, technological, and microwear attributes to interpret the artifact use.

#### Excavation Results

The excavations focused on collecting information to understand the site’s chronological and spatial context by examining the site formation processes and searching the area for material culture through artifact clusters and features. Geologic

studies and geomorphic data from the excavations show the ridge was part of an ancient levee from the Brazos River between 1.7 and 2 mya (Van Siclen 1991:663 Fig 8). Subsequent erosion by drainages formed several fingers and promoted slope erosion. Colluvial movement of sandy material from the ridge summit or Aeolian movement upslope from the drainage way followed the exposure of the underlying more resistant clayey material on the slopes in at least one episode and probably several occurrences over the 1.7 million years since the sediments were deposited. Evidence for this process was found in the bucket augering and soil profiles which found deeper sandy A and E horizons on the summit than on the slope as well as plinthic lag gravels along a clear E2 and Bt boundary. Paleoenvironmental research investigating the past 33,500 years suggest the area was on the boundary between scrub vegetation and grass lands to the west and deciduous forests to the east. Climatic changes at roughly 33,130 B.P., 14,500 B.P., 12,500 B.P. and 10,500 B.P. described by Bousman (1998:212 fig 7), Toomey and others (1993:306), and Richardson (2001:390) initiated vegetation changes and caused soil instability (Blum and Aslan 2005:183) that correspond with OSL dates of  $33,130 \pm 2850$  B.P.,  $14,730 \pm 1180$  B.P., and  $9010 \pm 740$  B.P. recovered from the profiles. Since the early part of the Post Glacial period the surface was relatively stable and any features created since this time would be disturbed primarily by bioturbation and modern mechanical excavation.

Photos taken during the initial surface collection and block excavations revealed three clusters of artifacts that included bifaces and debitage. The initial surface collection did not differentiate bifaces by clusters; however the visible clusters correspond with



excavation blocks that found between 2 and 5 flakes in the same block as each cluster. The debitage found in excavation and surface inspection included one wedge-like chip from Biface 23, 13 flakes (6 of the same Edwards chert as the bifaces and 7 of local gravels) and a quartzite hammerstone. The flakes not associated with a block excavation and the hammerstone were found near the surface of a block adjacent to one cluster during a second surface inspection before the block excavations. The several surface inspections of the stripped area, excavation of the barn floor material, as well as the screening of 30 bucket auger holes, seven 50x50 cm units adjacent to the stripped area, and three 2x1 m units across the landform did not find any additional artifacts. Excavations in the stripped area, 50x50 cm units, and 2x1 m units did not find any cultural features as the bifaces were found in only 30 to 60 cm of sandy loam with bioturbation most evident to 40 cm below the surface. Excavation of the barn floor where the mechanically excavated matrix was deposited found nine of the 26 bifaces indicating the majority of the spatial information was lost before the site was discovered. In light of the poor feature preservation in the sandy soil, the excavations did reveal the clustering of the bifaces and the debitage into distinct areas of the site and reduced the potential for finding additional artifact clusters on the landform.

### Biface Analysis

The cache analysis includes collecting metric, morphologic, and micro-wear data to frame the bifaces in a stage of production, typology, and potential use. Lithic material for the bifaces was identified by Banks (personal communication 2006) and described in

Banks (1990:124) as Edwards chert from the Farmers Ranch roughly 42 km north of Junction, Texas. The largest biface (Biface 21 at 321 mm long) only has cortex on the tip, indicating the ledge the material came from was more than 33 cm thick or cobble was more than 33 cm long. Based on similarities in outline and size, the collection was divided into three groups: Group 1 with long narrow bifaces, indistinct (similar outlines) tips and bases; Group 2 with relatively shorter and wider bifaces, more clearly identified tips and bases, one large flake dominates the tip remnant of early reduction; and Group 3 were prehistorically broken and reworked.

Reduction stage models relied on Young and Bonnicksen (1984 and 1985) for an approach to understand emic goals and behaviors of the cache creator(s), Bradley and Stanford (1987) for an understanding of the technological aspects in producing lanceolate projectile points, and Callahan (1979) for and documenting the changes in characteristics of ratios between the length, width, thickness, and edge angle through the reduction process. Following these three models, the Hegar cache exhibited sinuous, centered, strengthened edges in preparation of further shaping/thinning in the early to middle of Stage 3 of the Young and Bonnicksen (1984) model. The lenticular lateral cross-sections with roughly parallel sides, few hinge/step fractures are characteristics similar to Bradley and Stanford (1987) model. Lenticular cross-section and centered edge angles between 40 and 60 degrees with width/thickness ratios between 3.0 and 4.0 are most similar to Callahan (1979) Stage 3, but comparison of the Hegar bifaces to the sketches in Callahan's (1979) text suggest the bifaces are more similar to Stage 5 Shaping/Refining performs (1979:155 Figure 67). Comparisons between the Hegar

Cache and these three models indicate the caching craftsman performed the initial reduction and arranged the subsequent thinning while the final thinning and basal preparation is to be performed by the beneficiary.

Assuming the early stages of reduction reflect the intended form, the long, lanceolate bifaces are most similar in outline to Angostura projectile points; however, the size of the Hegar bifaces would produce projectile points significantly larger than the described type for the southern plains. Both Turner and Hester (1985:66-67) and Suhm and Jelks 9162:Plate 84) illustrate the Texas Angostura as having flat to concave bases and basal edge grinding of lanceolate points 50 to 100 mm long, 18 to 42 mm wide, and 12 to 18 mm thick. The Hegar bifaces average  $197 \pm 55$  mm long,  $54 \pm 4$  mm,  $14 \pm 5$  mm thick. Reducing the Hegar bifaces to Angostura points would require reducing the bifaces more than the anticipated 4% length, 39% width, and 8% thickness measured in either the Bradley and Stanford (1987) or the Callahan (1979) studies to reduce the experimental bifaces from Stage 3 to finished projectile points.

Micro-wear examination of the bifaces focuses on inventorying the location, kinds and intensity of wear by using a variety of magnifications then combining these three categories of information to discuss patterns of wear. Unfortunately, the history of the bifaces since discovery includes three sitting on the dashboard of the landowner's pickup for several years prior to discovering the major part of the cache. The remaining bifaces were excavated with a box blade followed by either remaining on the surface until rain and cattle trampling exposed them or they were transported to a barn in a backhoe bucket, and finally redeposit and packed into a floor surface. All of this

occurred after burial in Boy loamy fine sand (NRCS 2005) with highly acidic, fine-grain quartz sand with abundant water, rodent disturbances. The microwear analysis found every biface was heavily patinated and some had cortex forming within flake scars.

### Caching Behavior

Placing the Hegar cache in a temporal context and interpreting the function of the based on the available evidence is problematic. Unfortunately, pedogenic processes have both erase any organic features, removed non-lithic artifacts, and moved the remaining artifacts limiting the interpretation to the bifaces and scant additional lithic material.

Sites containing several large bifaces and few other artifacts are unique. The other artifacts, local and Edwards chert flakes as well as a hammerstone, suggest a Paleoindian to Early Archaic short term habitation. Regularly placed clusters of large bifaces fits general models of burials, but the absence of other items, e.g., complete projectile points typically associated with internments is suspicious. If the bifaces were close in size to serviceable tools or were found with items of a particular activity, e.g., scrapers and knives, then the cache features fit Binford's (1980:12) description of isolated context considered part of a planned seasonal movement as the bifaces would be used as either cores or tools for subsistence. The almost unserviceable size of most of the bifaces, described by Lintz and Saner (2002:37) as a dysfunctional feature, is indicative of a ceremonial use (Brown 1976:148; Johnson 1986; Campbell and Campbell 1981:26-27). Additionally, trade in the late Paleoindian/Early Archaic period is poorly understood as

populations are generally thought to be more mobile with poorly defined boundaries. As a currency the bifaces would represent a huge potential resource in the lithic poor gulf coast at any time, but once a biface is broken it loses much of its potential value but gains in practical value as only one of the 26 bifaces can produce a substantial amount of cutting edge in flakes and its own serviceable edge. As a prestige item, a biface of this size and quality of material is unique, and would have widespread symbolic value representing a connection with real and imaginary forces. But, like Lintz and Saner (2002:42), the occurrence of so many large bifaces suggest the cache is not a shaman's tool kit but it may represent the storage of material by someone who trades in ceremonial items.

Using this excavation and artifact analysis information the interpretation of the cache focuses on comparing the data to the various purpose of the cache. In general, caches provide storage for material and items in sufficient quantity to satisfy either a predictable need or as security in an unknown situation. These requirements are divided into four conditions: Provisioning a place for future need, banking/insurance, trade, or ritualistic.

The Hegar cache as a provision for a future need should follow the Optimal Foraging Theory. In this theory, a cache is a decision to make a resource patch with a known quantity to be exploited at predicted time in the future. Caches in an isolated context are associated with Paleoindian/Early Archaic resource scheduling to offset shortages in specific environments (Binford 1980:12) and as a means of distributing gear to increase utility (Binford 1979:270). Caching would preclude frequent visits to the

quarry (Hoffman 1992:203) and should contain larger items with less reworking and they represent the need to have large durable edge (Kuhn 1994). Caches for provisioning a place for future need should include a large number of early stage items, such as blades or bifaces, which can be made into a variety of tools and match the expected need. The discovery of 14 blades in the Keven Davis cache in Navarro County, Texas with minimally used edges (Collins 1999) serves as the best and geographically closest example of a provisioning cache. Provisioning a place for future need would also necessitate a mobile lifestyle. If Hegar is a provisioning location, then the cache must be the result of a small group that travels seasonally from the coast to the southern plains and needed reliable lithic material at a point where they knew they would need tools they could manufacture from the bifaces to get to the Edwards Plateau. Contrary to this hypothesis, the cache is not part of a larger, frequently visited, site. Nor were a variety of items found on the site that would suggest storage of tools for use in the different environments of the Gulf Coast and Southern Plains.

The Hegar cache as banking/insurance provides security but is not utilized unless needed. Cached items are often stored in isolated context near distinctive landmarks (Miller 1993: 13; Rathje and Schiffer 1982; Button 1989:216; Scott *et al.* 1986:15) in an area with the goal of aiding in an unexpected need at an unknown time in the future (Binford 1979:257). These caches are more common in environments with extreme conditions that can be life-threatening. A banking/insurance cache should include a variety of material needed for survival, e.g., food or enough material to survive scattered across a landscape near places of need that are easy to find. The Hegar cache does not

meet the criteria for a banking/insurance cache because the cache is a large number of similar items that exceed survival needs and there is no modern evidence of either an extreme environment or distinctive land mark that would require a survival cache or make a cache easy to locate.

The Hegar cache as a part of a trade system includes the storage of goods for the purpose of retrieving them at a later time for trade (Miller 1993:11; Scott *et al.* 1986:15) or storing the goods for someone else to recover and leave an equal value of desired items in a delayed exchange (Jochim 1981:177). Trade caching represents a safe location between transport in isolated context near a territorial boundary where there is a mutual reliance specialized resources outside the group territory either in direct or delayed exchange. Trade of bifaces is practical because the general form is both durable and can be fashioned into a variety of tools. This basic form assumes these basic forms are ready for refinement and have minimal to no use-wear. Additionally, a trade cache should have a large amount of material. As trade of subsistence related items, a cache of bifaces should have both an abundance of material and be of a suitable size for the consumer. The best example of this kind of lithic trade is the description by Scott and others (1986:17-18) of obsidian bifaces traded as ceremonial items, currency, and trade by the Karok on a “currency belt”. As a symbol of alliance or power, cached items would most likely be cached for personal security and displayed as a symbol of power or wealth when trading (Walthal and Koldhoff 1998:268). Cached items would not be on the site as a provisioning cache, but off site in a hidden location known only to the owner. The Hegar cache fits the definition and description of a trade cache. The large

number of early stage bifaces made from central Texas material, near the physiographic boundary of the Coastal Plain and the Interior Coastal Plains (BEG 1996), and near the junction of three major modern vegetation types: Pine-Hardwood forest to the northeast, Post Oak wood forest to the northwest, and Grasslands along the coast (BEG 2000) all suggest the Hegar cache may be near a larger site. The location of the cache on the slope would also be concealed requiring specific knowledge of the landform to find the cache.

Ritualistic caching at Hegar should include rare items produced in a ritual context with little to distinguish caching of ritualistic objects from ritual discard associated with burials or votive caches which include implements, ornaments, and exotic artifacts (Bement 1991; Taylor and Highley 1993) and include rare, finished form, unusual size, unusual shape items with fine workmanship from labor or skill intensive production Luedtke (1976:320). Descriptions and uses of ritualistic objects are ethnographically described and documented in the archaeological literature for the Gulf Coast area. Lintz and Saner (2002) describe the Hoerster cache in central Texas and associate the one large biface in the collection to similar items found associated with burials in 41KL4 on Padre Island (Campbell 1964 and Johnson 1986:30) and burials near both Rockport and Corpus Cristi (Johnson 1986); however, the associated bifaces were singular ritualistic items associated with shamen and not caches (Lintz and Saner 2002:42). Like Lintz and Saner (2002), Johnson (1985) describes a heavily patinated, 26 cm long chert knife found in a shell midden on 41NU190 adjacent to the Nuches River associated with Early and Middle Archaic projectile points (Johnson 1985:23-25). Johnson included a description by Cabeza de Vaca of the “Mala Cosa” as a feared



individual that performed ritualistic surgeries on Avavares individuals by making three “cuts” along the abdomen or limb with a large knife, the Mala Cosa then physically pulled the sickness or injury from individual and instantly healing the person (Johnson 1985:27). Additionally, the Avavares placed significance on the number 3 (Johnson 1986:28) and only Shamen or important people could keep a large knife because of the revered status and symbolism (Johnson 1985:35). Unlike the ceremonial knives described in Lintz and Saner (2002) and Johnson (1986), the Hegar bifaces are relatively unfinished early reduction stage items but maintain a durable form. The significance of Johnson’s description of the knives and their use is relevant to the Hegar cache is several ways. Most notably, the physical descriptions of the knives in the ethnographic account and patination found on the knife on 41NU190 in comparison to the other artifacts; the descriptions are very similar in size and shape and the Hegar bifaces are all heavily patinated while other artifacts from the site are not. Unfortunately, the few photos of the initial biface clusters at Hegar do not show clustering by size or other characteristics. No direct association can be made between Johnson’s descriptions of the significance or ownership to the Hegar cache, but the description of the size and patination characteristics are comparable.

## Summary

If the Hegar cache represents provisioning a place for future, then makers of the cache built a patch resource following the models developed as part of the Optimal Foraging Theory with cost of collecting materials, manufacturing bifaces, transporting

them to the location, and creating the cache occurring in a planned behavior before the stress is evident. In this instance, Hegar should be the result of a Paleoindian or Early Archaic group that travels seasonally between the Gulf Coast and the Southern Plains. It is expected that the cache would be on a larger, frequently visited, site and a variety of items would be in the immediate area. Despite the large size and rough association with Angostura type artifacts, there are no other characteristics of the site that match the criteria for provisioning a place for future need.

If the Hegar cache represents a banking/insurance cache, than the makers were anticipating a short term stress like bad weather or loss of equipment in an accident. A banking/insurance cache should contain items needed for survival until the emergency is over and more stable resources can be obtained. In this instance, the Hegar cache should be near a distinctive marker or an environmental hazard that would necessitate emergency storage. The Hegar cache neither contains a variety of items for survival, the quantity needed for subsistence, nor does paleoenvironmental and geologic information suggest there is an environmental hazard in the area that precludes needing emergency supplies.

If the Hegar cache represents a trade cache, than it may represent either safe storage until needed or it may be part of a delayed exchange. As a trade location, it may also represent a territorial boundary with populations on the coast and inland trading surpluses for needed items. In this instance, the Hegar cache should be near a larger site with a diverse collection of artifacts. No site was identified during the excavations; however, several prominent ridges were within sight of the cache and have not been

explored. Hegar fits the definition of a trade cache with a large number of similar early stage items that are exotic to the area. It should date to the Archaic and possibly the Late Prehistoric; however, no diagnostic features or artifacts were found to clearly identify a time period or cultural tradition.

If the Hegar cache represents a ritualistic caching, than it should include items that are rare, in finished form, and have characteristics that would make the items impractical for utilitarian use. The Hegar cache is a collection of rare items with impractical size and shape; however, they are not in “finished” form unless they were not intended for actual cutting. The account of the Mala Cosa, the description of the patination of the biface at 41NU190, and the significance of the number 3 correspond to the Hegar cache as a ritualistic deposit: the Mala Cosa wielding a large knife and performing ritualistic surgeries would require a large biface without a serviceable edge, the patination may be accelerated by this frequent handling and would account for the difference between the bifaces and debitage in the amount of patination, three clusters of bifaces would also lend ideological reinforcement to a territorial boundary. Like the trade hypothesis, the ritualistic cache should occur near a site and may represent a territorial boundary between Archaic or even Late Prehistoric populations.

Hegar cache includes 26 large lanceolate or leaf-shaped Edwards chert bifaces stored at an early stage of manufacture. Excavations found no additional evidence of diagnostic artifacts or cultural features but did reveal the bifaces and associated flakes came from three distinct clusters on the shoulder slope of a ridge that was deflated and covered with sandy material in several episodes of soil instability associated with

climatic changes. Analysis of the bifaces suggests they are most similar to the Angostura projectile point type but because the bifaces are in an early stage of reduction they cannot be clearly associated with a specific projectile point type. A microwear analysis found no substantial usewear but did document heavy patination across the bifaces but not in a pattern indicative of use as utilitarian tools. Examination of the cognitive functions associated with caching lead to an interpretation that the cache is associated with trade because of the large and high quality quantity of material as well as the proximity to a cultural and environmental boundary. The large size of the bifaces suggests a status or ritualistic intention, but the excavation and analysis data supports only a limited interpretation.

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APPENDIX A  
BIFACE ANALYSIS

**Biface 1**

Dimensions: Length 142 mm, Width 50 mm, Thickness 12 mm, Edge Angle 30° (Figure A-1).

Tip: General shape is rounded in cross-section and thick in profile. Heavy patination present more on Face A and edge than Face B. Both faces have flakes similar to end thinning in Clovis bifaces.

Face A: Minor patination along flake arrises over entire face. Four large feather edge flakes extend to the midline from the left edge. Few short steep flakes interrupt the edge and larger flakes. An unidentified residue forms a single line from the left edge toward center of biface on Face A (1. at 40X).

Face B: Minor patination along flake arrises over entire face. The remains of large feather edged flake scars dominate the middle of the biface leaving a weak ridge along the midline. The edges are dominated by irregularly spaced, shorter steeper flake scars. All of the flaking in the indentation near the base is on this face. Flakes are generally short forming a steep edge.

Base: Single snap fracture

Edge: The edge with the indented portion near the base is convex with more short deep flake scars while the edge opposite the indented portion of the base is straighter and more regular the length of the biface. Both edges are heavily patinated with very small step and hinge fracture areas are small but occur along the entire edge.

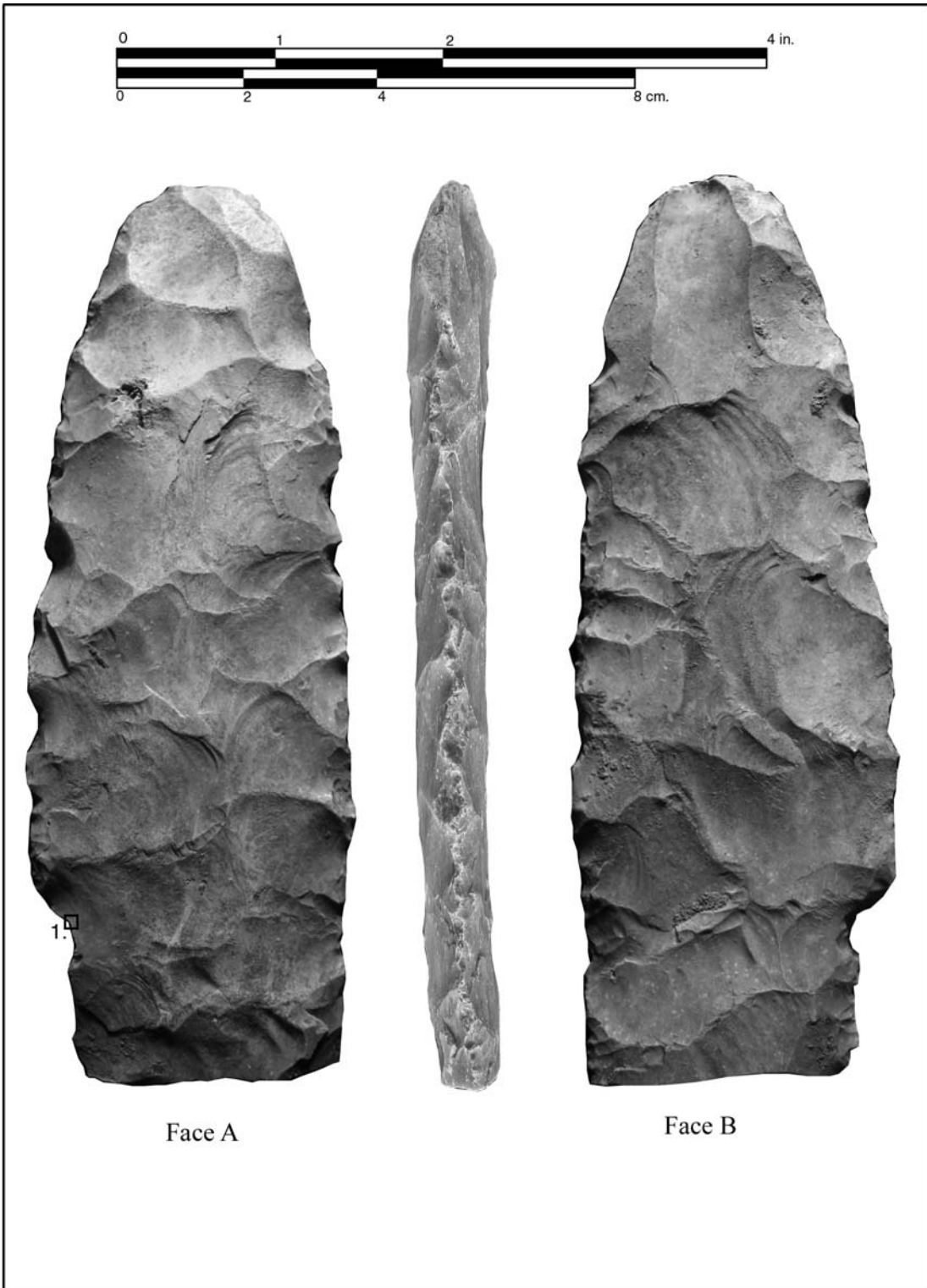


Figure A-1. Biface 1

**Biface 2**

Dimensions: Length 135 mm, Width 48 mm, Thickness 13 mm, Edge Angle 40° (Figure A-2).

Tip: Large flake scars dominate Face A while smaller scars converging on a single point are present on Face B. These different flaking patterns tilt the cross-section of the tip toward Face A.

Face A: Patination on all surfaces of Face A. Three large feather edge flake scars dominate the face and extend from the left edge over the mid section while the right edge has smaller scars forcing the midline ridge toward the right edge. Two of the scars on the right edge are particularly steep and are from modern damage, like the base fracture. These fractures are linked to scattered residue on the face (a.) and linear residue (b.). A large fresh-edge flake scar on the left edge at the base is most likely a result of what broke the artifact.

Face B: Four large feathered edge flake scars extend beyond the midline of the biface similar to Face A. Directional and isolated plow residue is present near the base (c.)

Base: The base is a single snap fracture possibly initiated in the lower corner when a deep flake snapped the tool (Box blade damage). Plow residue present at break (c. on Face B).

Edge: Three steep flake scars (two on Face A and one on Face B). Between the large scars there are small areas with more rounded edges than the larger scars (1).

General Notes: Two notch like flakes 67 mm from tip on one edge and a third on opposite edge 38 mm from tip.



**Biface 3**

Dimensions: Length 136 mm, Width 55 mm, Thickness 15 mm, Edge Angle 40° (Figure A-3).

Tip: Ill-defined and formed from large flake scars.

Face A: Three large flake scars from the right edge dominate the face while the left edge has several small flake scars. Two large patches of residue along centerline are also obvious (a. and b.). Plow residue in the center of the biface (a.) has a diagonal direction while one near base is non-directional.

Face B: Only one large overshoot flake is near the tip, all other scars that form the interior were impacted by smaller, shape forming scars along the edge.

Base: Single recent fracture. Plow residue present at break (b. on Face A).

Edge: Irregular with edge preparation and platforms evident.

General Notes: Patination dominates both face surfaces. This biface appears to be an early stage of reduction with large flakes that extend past the midline with few other flakes to form the edges. Other indicators of early reduction are the general thick and irregular cross-section.

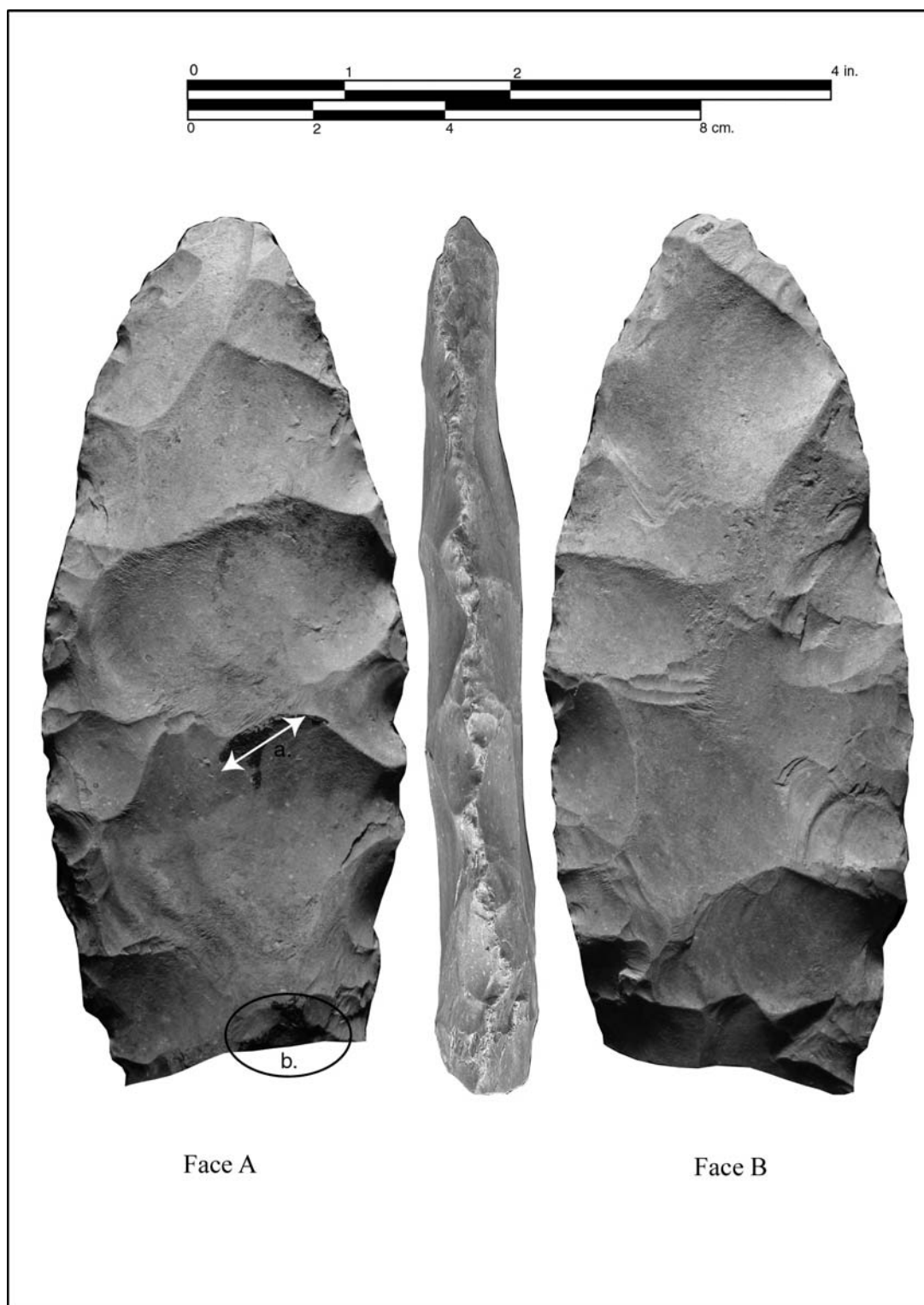


Figure A-3. Biface 3

**Biface 4**

Dimensions: Length 119 mm, Width 51 mm, Thickness 13 mm, Edge Angle 35° (Figure A-4).

Tip: General shape, formed from large deep flake scars.

Face A: No large flake scars visible from edge to centerline; all central scars are from an earlier stage of reduction. Residue in two scratches near edge (1. at 10X) and at 2. at 25X (Figure A-4a). Light patination along arris over entire face.

Face B: Only two scars extend from the left edge to the centerline. Residue along arris in two locations (3. at 16X) and directional in one (4. 8X)

Base: Like the tip, it is general in shape with steep, deep flake scars.

Edge: Irregular with edge preparation and platforms evident. Microphotographs at 8, 20, and 100X show patination.

General Notes: Possibly heat treated material with waxy surface appearance. Both faces have minor patination over the entire surface. This biface is different than the others in size (smaller) and less obvious patination. Thick cross-section, irregular outline, and steep flake scars suggest an earlier stage of reduction.



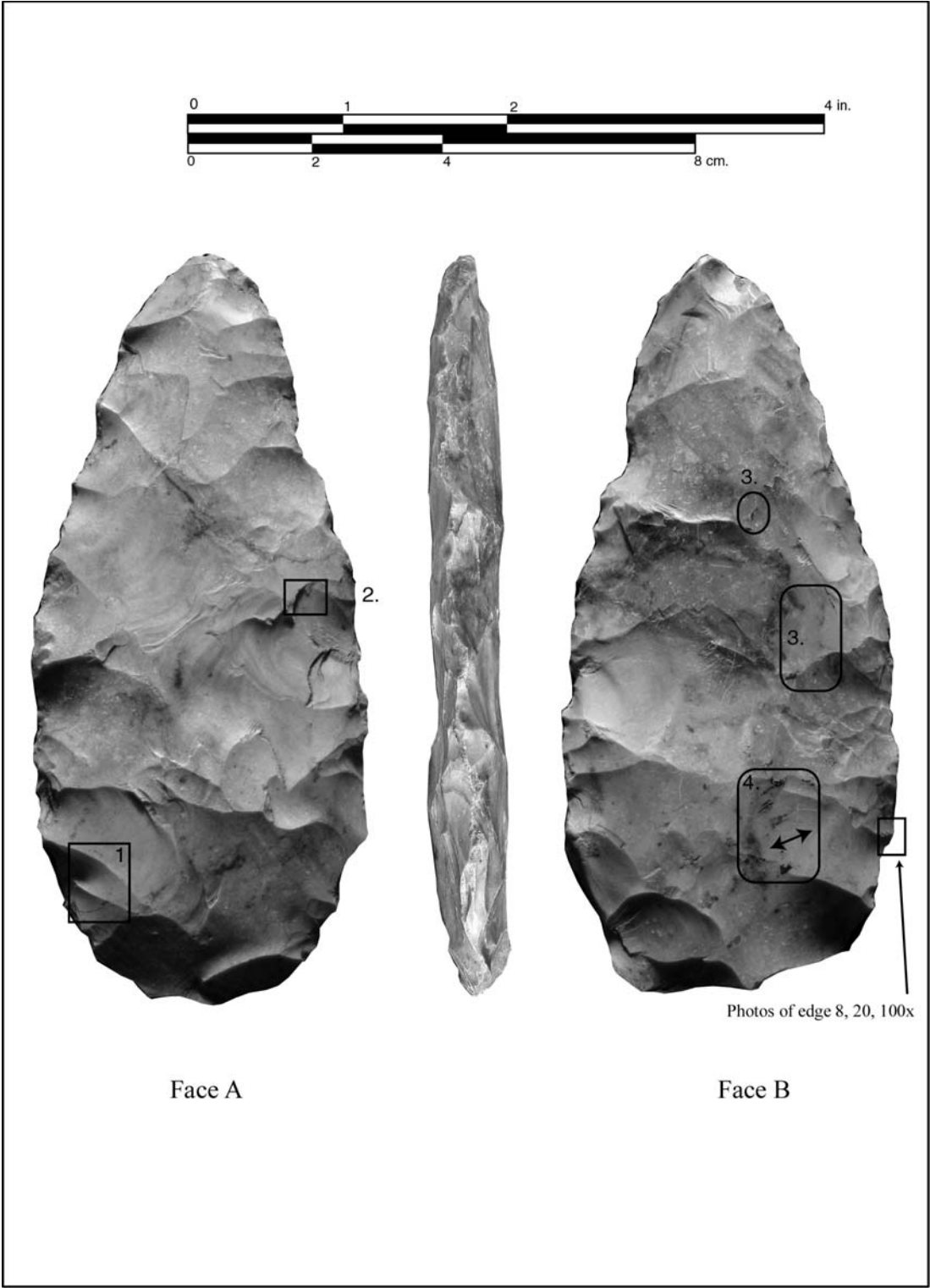


Figure A-4. Biface 4

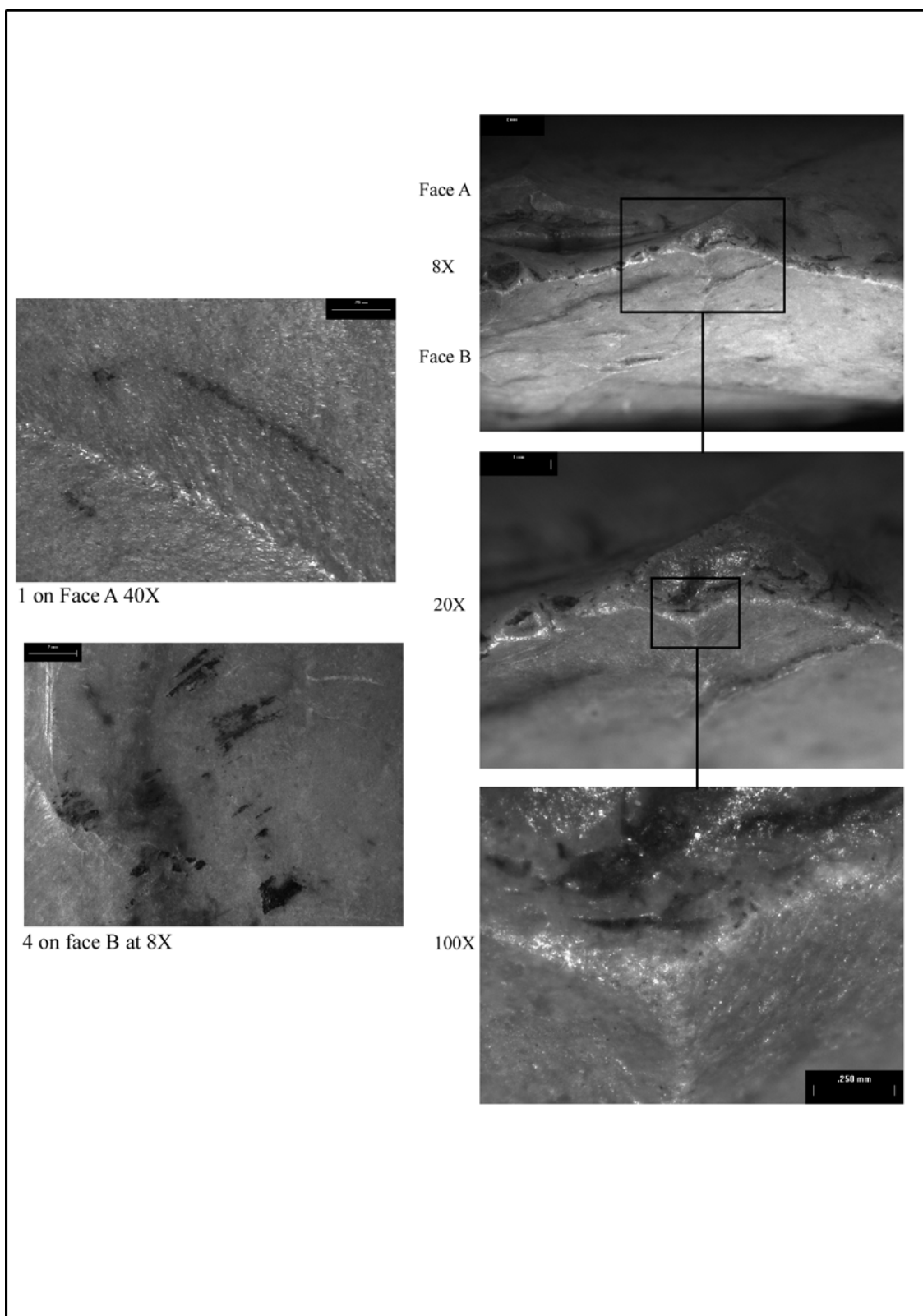


Figure A-4a. Biface 4 Microphotographs

**Biface 5**

Dimensions: Length 240 mm, Width 52 mm, Thickness 140 mm, Edge Angle 40°

(Figure A-5).

Tip: Like the base, the tip it has cortex from original source material. The outline is generally straighter and at a more narrow angle than the base.

Face A: Large feather edge flake scars are equal from both edges and meet at the centerline. Large scars are separated by isolated areas with smaller scars and more intense patination (1.) (Figure A-5a). Photomicrographs of isolated polish (2.) at 100, 200, and 500X.

Face B: Like Face A, large feather edge flake scars extend from both edges and are separated by smaller scars and more intense patination along the edge. Isolated polish (2.). Directional lines of patination (3.) in the flake scar that follow the same “path” as spots of residue (4.).

Base: Similar to the tip with cortex. Slightly rounder outline.

Edge: Fairly straight.

General Notes: Eleven flakes extend to the midline. More polish than any other artifact.

Deep notch-like flakes and residue are from modern blade damage.

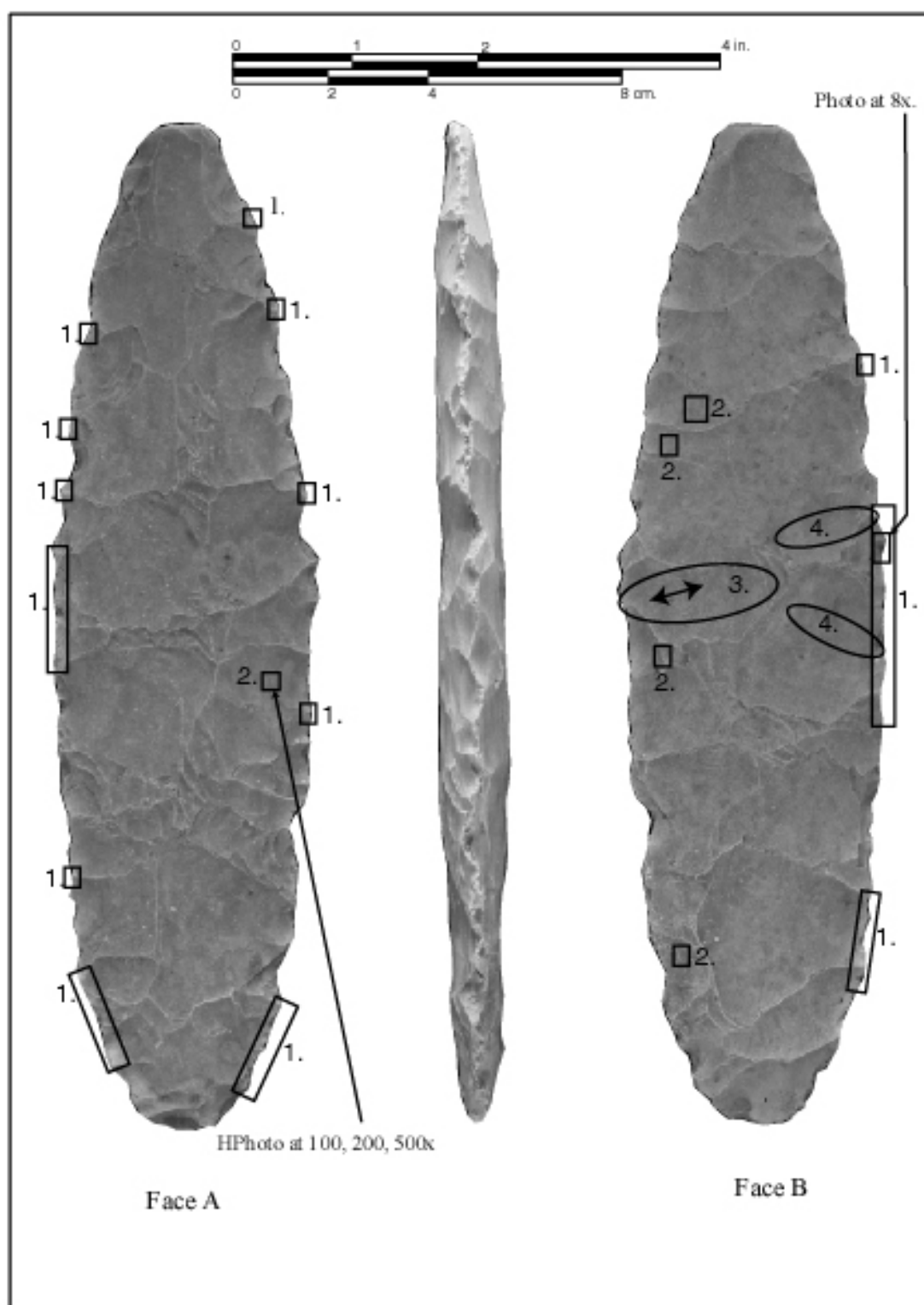


Figure A-5. Biface 5

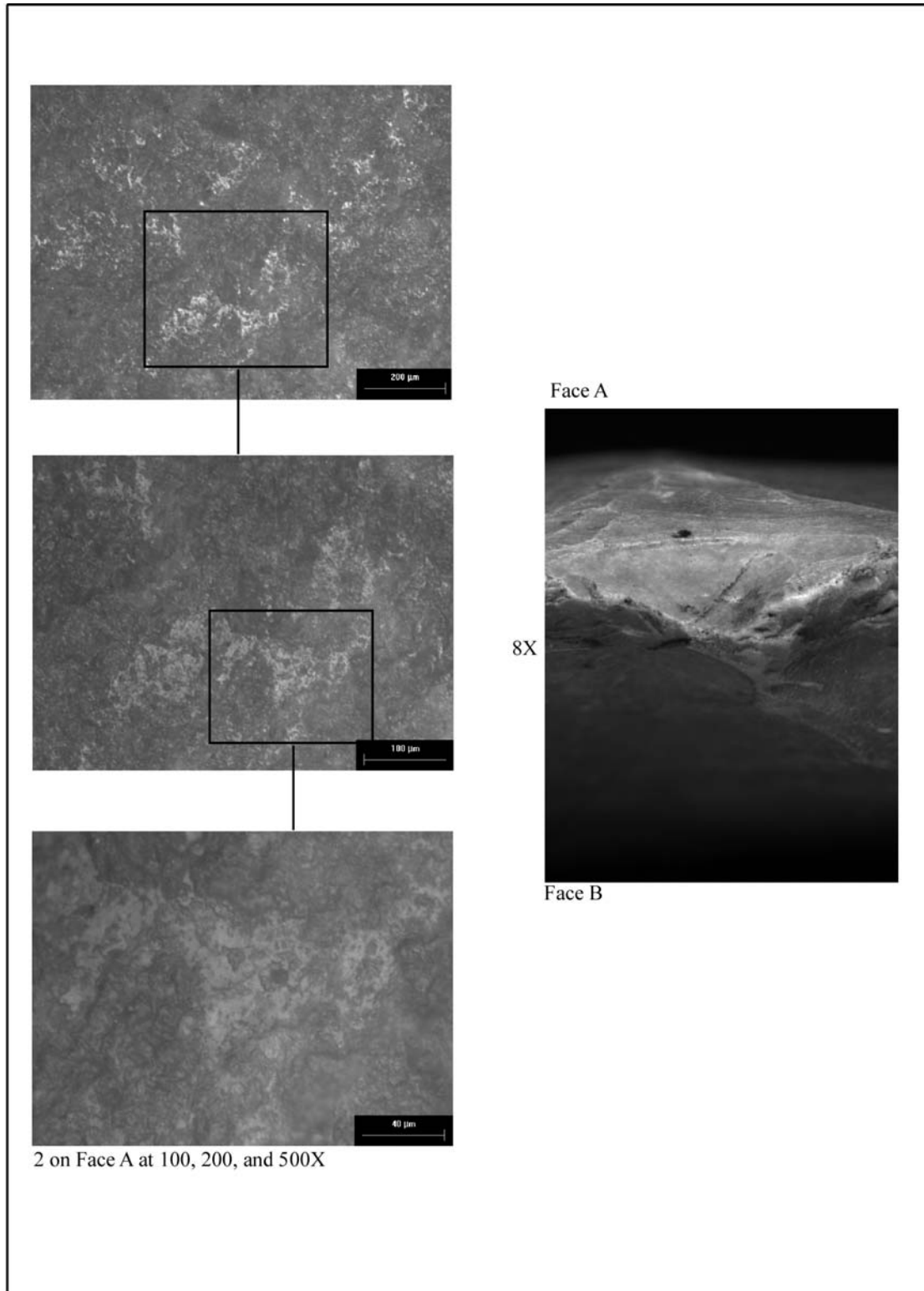


Figure A-5a. Biface 5 Photomicrographs

### **Biface 6**

Dimensions: Length 180 mm, Width 54 mm, Thickness 16 mm, Edge Angle 45° (Figure A-6).

Tip: The tip is skewed toward right edge of Face A. Cortex is present on face and edges.

Face A: Several large flakes but none clearly overshoot. Cortex covers about one-third of face and is mostly along the centerline. Cortex appears as rounding/smoothing with isolated polish on arrises within 3 mm and over the entire left edge (1. at 8X) at (2. at 16X). Isolated polish was found along flake arris (3. at 8X).

Face B: Several large flakes but none clearly overshoot. Cortex is evident near the tip and base with an additional spot near the center. The left edge has rounding/smoothing with isolated polish on old arrises between more recent flake scars (4. at 8X). Light rounding/smoothing on flake arris on top of cortex (5. at 8X). There is isolated polish on arris (6. at 8X) and in a flake scar (7. at 12X).

Base: the base is only slightly more rounded than the base with cortex on both faces and the edges.

Edge: Sinuous with platforms made by step/hinge fractures. The edge near base and tip has cortex but some rounding/smoothing is evident on top of the cortex.

General Notes: Cortex present in various spots along tip, base, and edges but occurred after flaking in all instances. The rounding/smoothing observed is over cortex and may be part of the patination and not usewear.

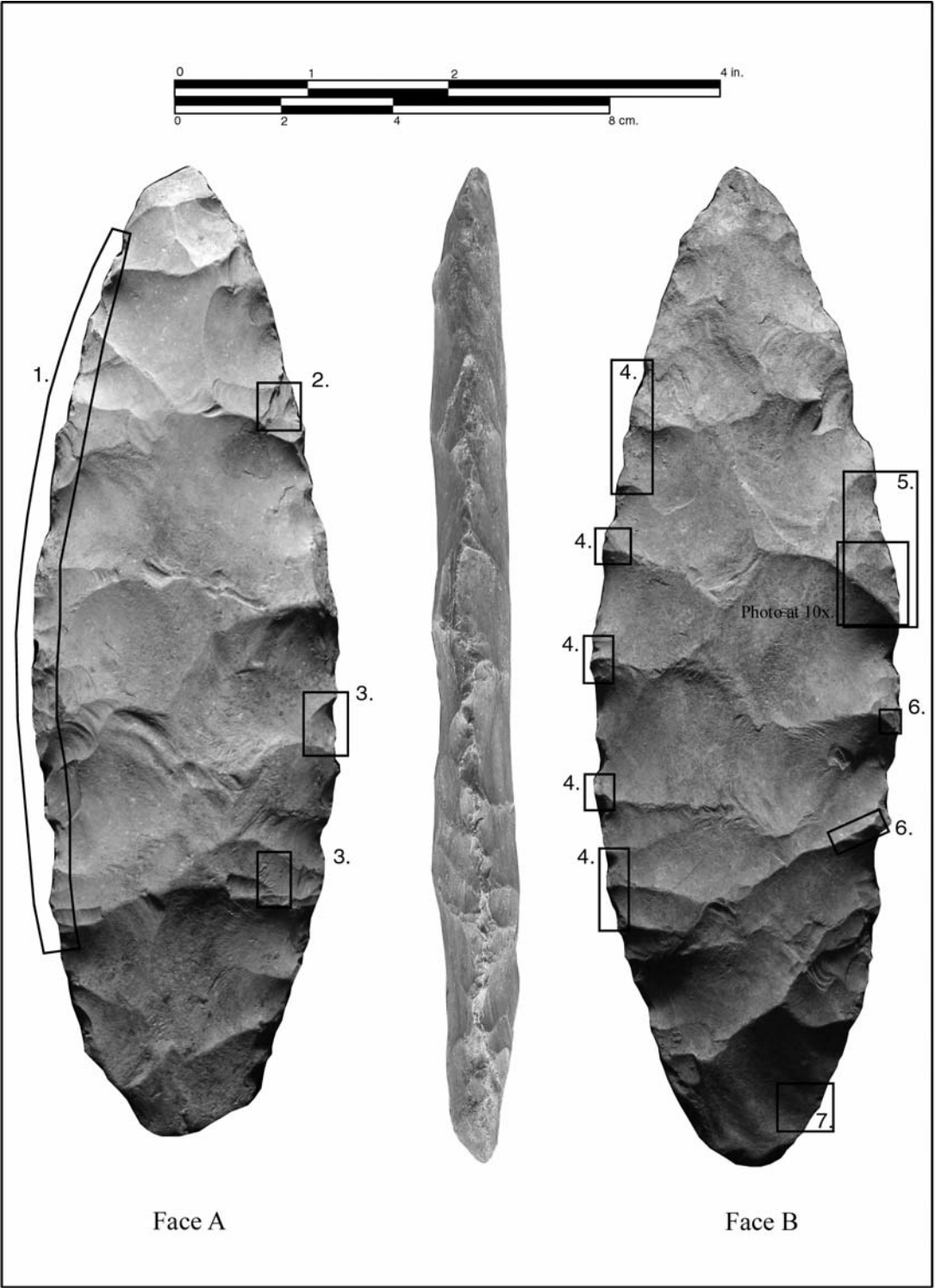


Figure A-6. Biface 6

**Biface 7**

Dimensions: Length 224 mm, Width 50 mm, Thickness 16 mm, Edge Angle 45° (Figure A-7).

Tip: The tip is irregular with a rounded outline and large deep flakes dominating the surface. Overall outline is very similar to the base with the only distinguishing characteristic being the thinner cross-section of the tip.

Face A: Three flakes extend from the left edge past the midline; all other flakes terminate before the midline or the interior flakes are from an earlier stage of reduction. This flaking pattern forms a weak midline ridge. The most recent flake scars are deep, having broken the edge and have less patination near the Directional residue near the mid-section (a.) and non-directional residue near the edge (b.) (Figure A-7a). The combination of broken edge and residue suggest the break in the biface was from the box blade striking the biface. Isolated polish (1.) in a flake scar.

Face B: All but two flakes have feather terminations at the midline ridge. Spots of residue (c.) and residue in a pot-lid-like fracture (d.). Like Face A, there are few areas of smaller flakes between the larger flakes.

Base: The base is tilted toward the right edge of Face A. Patination is heavy on the base.

Edge: The edge is sinuous with alternating flake scars on opposite faces. Patination dominates the edge (Examples of edge at 8X and 100X (4.) but deep flakes have broken the edge with less worn edges.

General Notes: Biface is broken in two pieces with a fresh fracture and evidence of the box blade impacting the biface at the fracture. Like the other bifaces, the flake arrises and the edge have light to moderate patination.



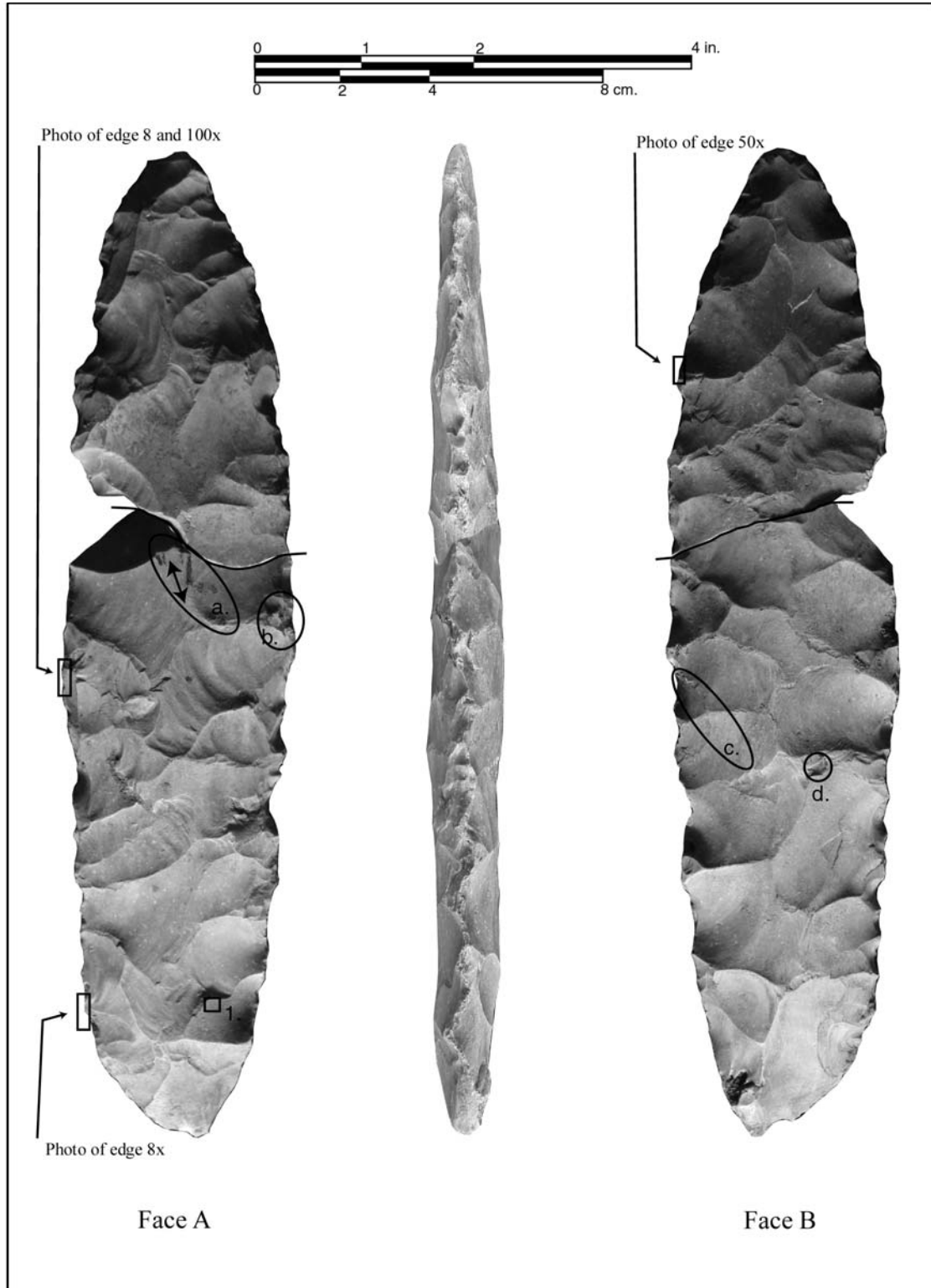


Figure A-7. Biface 7



**Biface 8**

Dimensions: Length 196 mm, Width 60 mm, Thickness 15 mm, Edge Angle 45° (Figure A-8).

Tip: Tilted to left edge of Face A. Opposite edge has steep flake that is heavily patinated.

Face A: Five of the flake scars from the left edge extend to or past the midline while the scars from the right edge generally terminate at or short of the midline. The larger scars are separated by areas of smaller scars along the edge (presumably to smooth the edge to a more regular outline). There is more patination on this face than Face B.

Face B: This face is dominated by regularly spaced large feather edge flakes that form a strong midline ridge. Few small deep flake scars are evident along the edges and are most likely from damage to the edge but none have broken the general shape of the edge.

Base: The base has a rounded outline with the left of edge of each face having one large scar and the right edges having three to four small steep flake scars.

Edge: The edge is sinuous with alternating flake scars from both faces. Both lateral edges have multiple areas with hinge/step fractures with patination over the scars (Figure A-8a).

General Notes: The regular spacing of flake scars and maintained sinuous edge suggest this biface is at a mid stage of reduction and is prepared for further reduction to a final leaf or lanceolate form. Moderate to heavy patination on all surfaces.

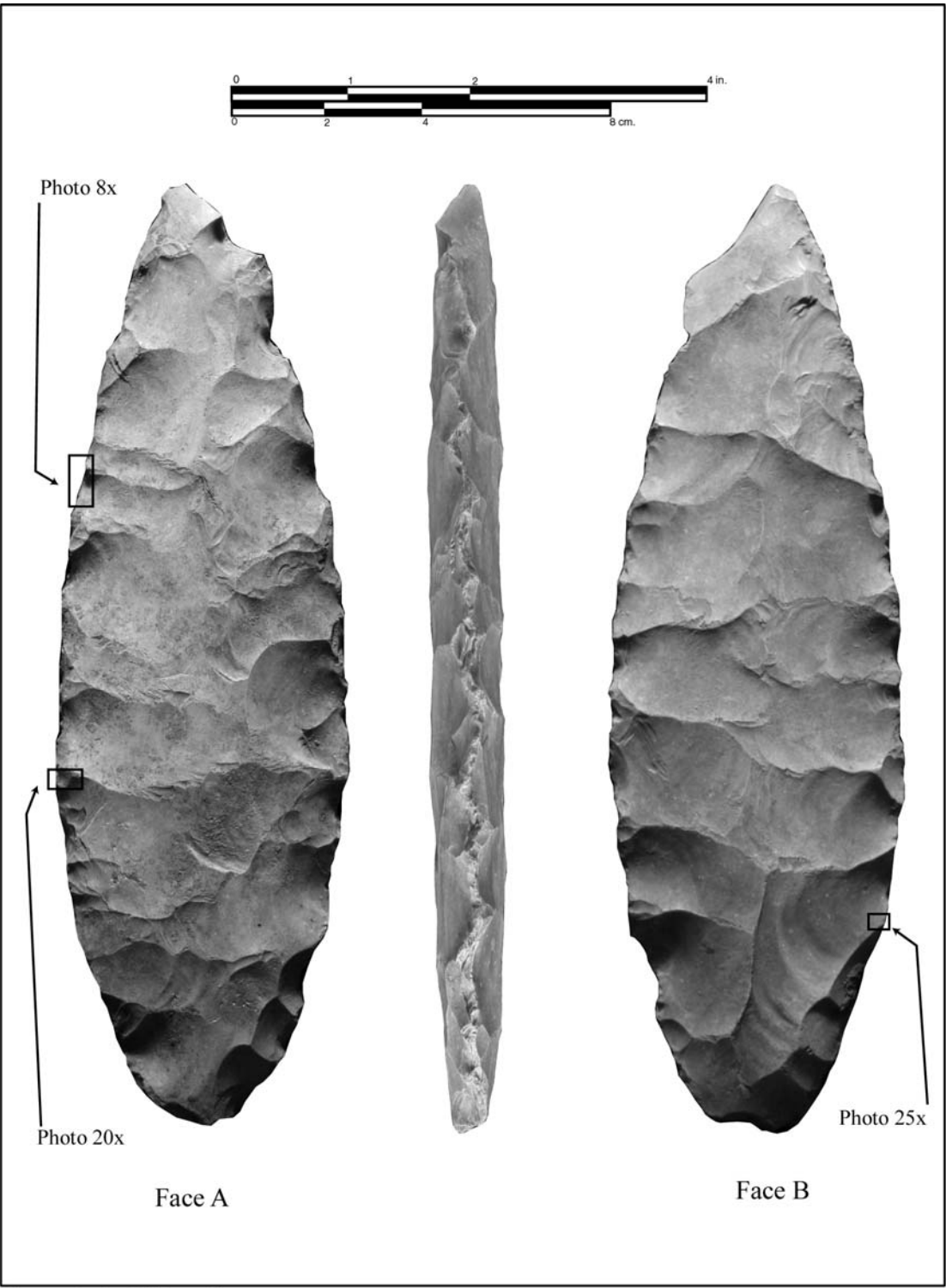
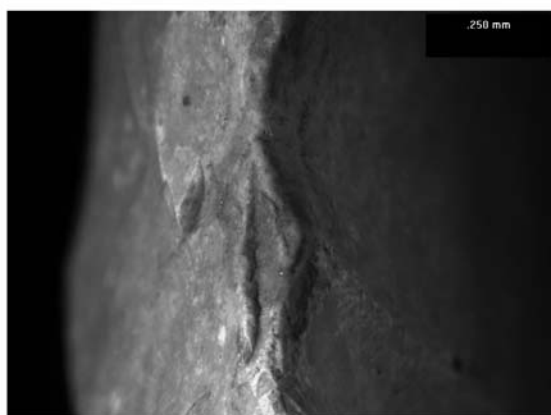
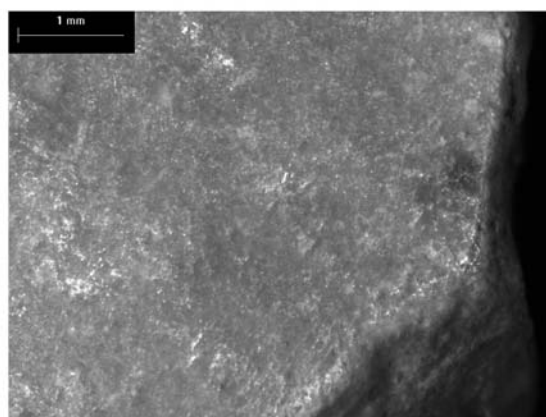


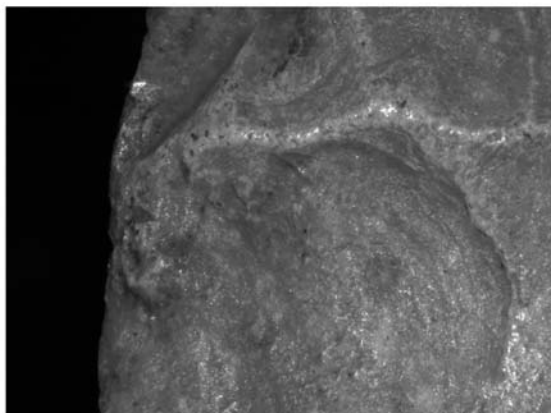
Figure A-8. Biface 8



Upper left edge of Face A at 8X



Lower right edge of Face B at 25X



Lower left edge of Face A at 20X

Figure A-8a. Biface 8 photomicrographs

**Biface 9**

Dimensions: Length 201 mm, Width 55 mm, Thickness 16 mm, Edge Angle 45° (Figure A-9).

Tip: Most of the flaking on the tip is on Face A. Face B has fewer flakes and is covered in heavy patination. The tip is skewed toward Face A left edge.

Face A: Few large flakes dominate the surface with several smaller flakes along the edge that only extend about 1 cm onto the surface. Flake scars near the tip extend over the midline, while scars closer to the midsection and base extend roughly a quarter of the way toward the midline. There are three areas of moderate isolated polish away from the edge (1. at 20X)

Face B: There is heavy patination over two-thirds of the face with the lower left edge less patinated. Patination is evident at 10X (2.)

Edge: The edge is sinuous with alternating flake scars from both faces. Both lateral edges have multiple areas with hinge/step fractures with patination over the scars.

Areas with heavy patination are separated by more recent retouch scars.

General Notes: Patination on both faces but heavier on Face B with only a few flakes along the left edge not severely rounded by patination.

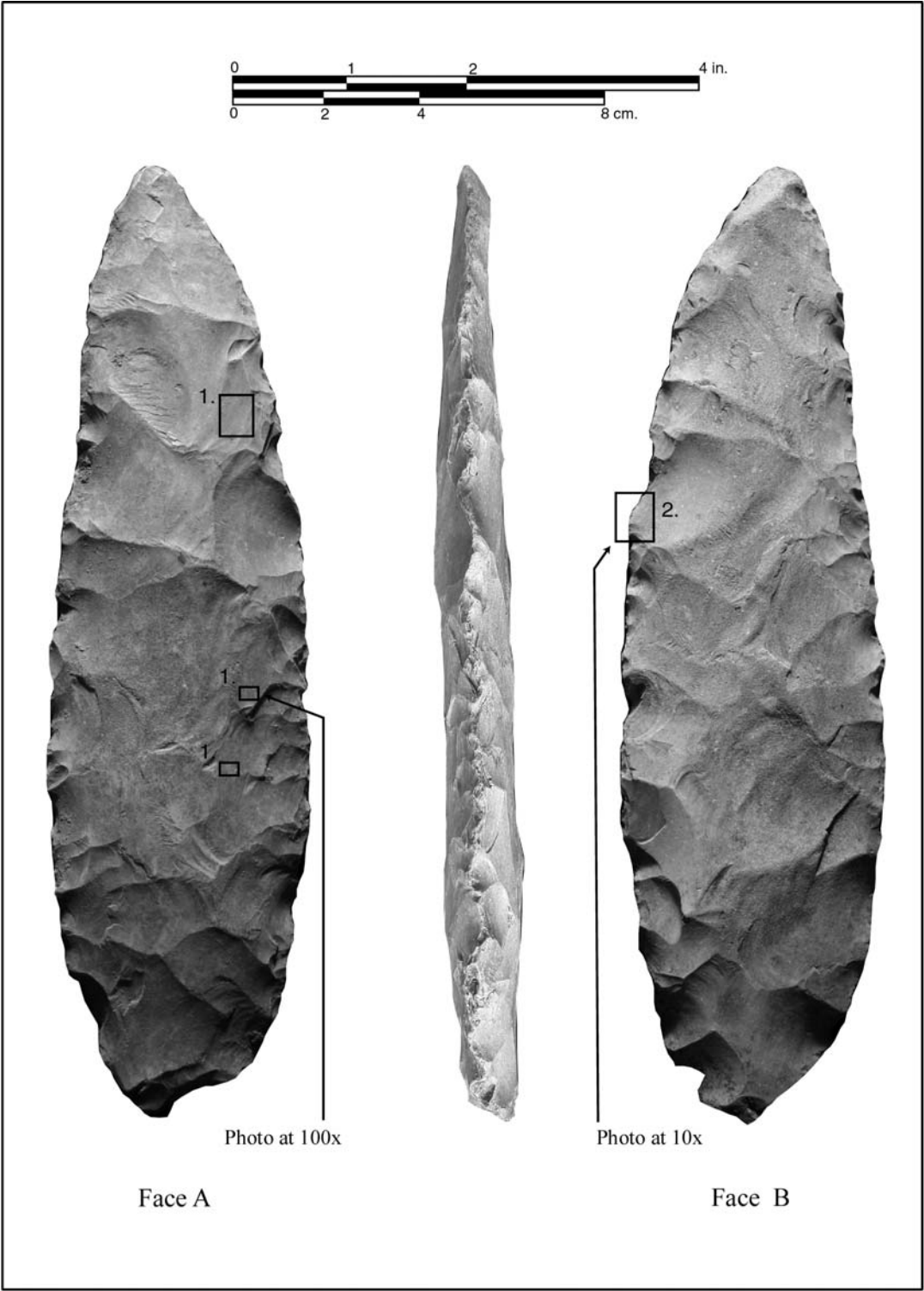


Figure A-9. Biface 9

**Biface 10**

Dimensions: Length 232 mm, Width 52 mm, Thickness 15 mm, Edge Angle 50° (Figure A-10).

Tip: The tip is narrow and rounded in outline. Patination is evident but not heavy.

Face A: Flakes from both edges meet to form a midline. The flakes from the left edge are generally smaller with more areas of smaller flakes removed between the larger flakes while the right edge is predominantly large flake scars with more isolated smaller scars. This pattern left the right edge also more irregular than left edge. Photo of edge patination at 10X (1.).

Face B: The face has large feather edge flake scars from both edges that meet in the middle forming a midline ridge similar to the right edge of Face A. A linear pattern of spot residue was found across the mid section of the biface (2. photo at 100X). Unlike the box blade, this residue is not directional but does follow a linear pattern.

Base: The base is a single flake scar on Face A.

Edge: The edge is sinuous with alternating flake scars from opposite faces.

General Notes: Patination on most of the surfaces but most prominent on the edge, the tip and base.



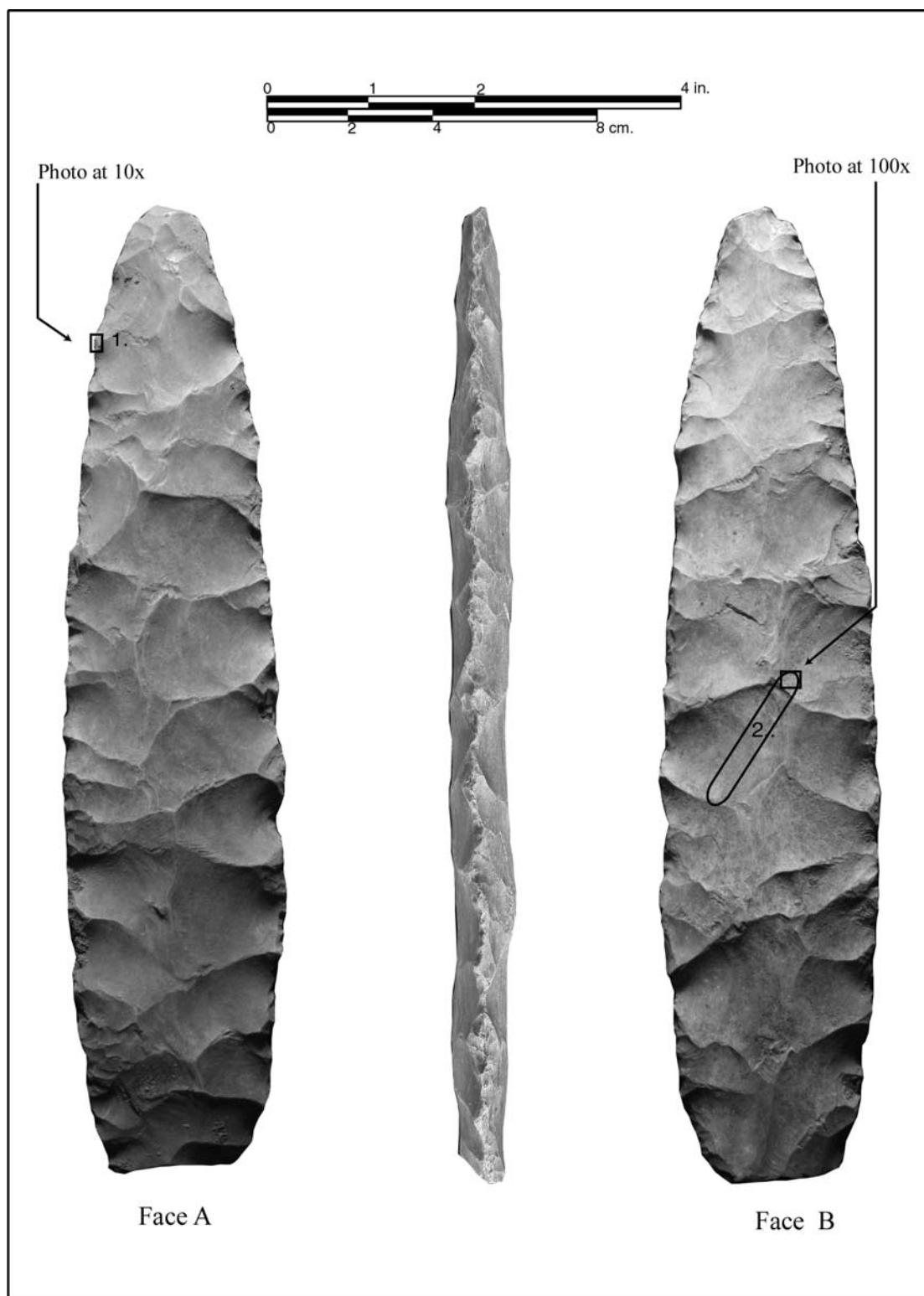


Figure A-10. Biface 10

**Biface 11**

Dimensions: Length 243 mm, Width 53 mm, Thickness 14 mm, Edge Angle 45° (Figure A-11).

Tip: The tip has a narrow outline with residue on top of heavy patination that covers the tip and right edge of Face A (1. at 100X) (Figure A-11a). This residue is most likely from a metal blade.

Face A: Large feather termination flake scars dominate the face with few areas of small scars separating the larger flakes. Patination covers most of the surface. There are several spots of residue along the midline ridge (1.) and near the base (2. and 8 and 100X).

Face B: This face is similar to Face A with large feather terminated flake scars forming a central ridge. There are few smaller scars between the larger scars suggesting limited edge preparation after thinning. Also, the outline is uneven with several short steep flake scars between the larger thinning flake scars.

Base: Flake size does not vary closer to the base. Patination dominates the surface.

Edge: The edge changes from more sinuous near the tip with alternating thinning flake scars on either face to more broken and irregular with several minute hinge/step fractures in the midsection and base. Overall, the edges are sinuous.

General Notes: Like many of the bifaces, this one is broken in two and has residue from the object that broke the biface on the tip, but the residue on the base is spotted instead of a linear deposit. While the residue on the base is unlike the residue from the box blade, it does not appear to be hafting related because it is not found around the base on both faces or the edge.

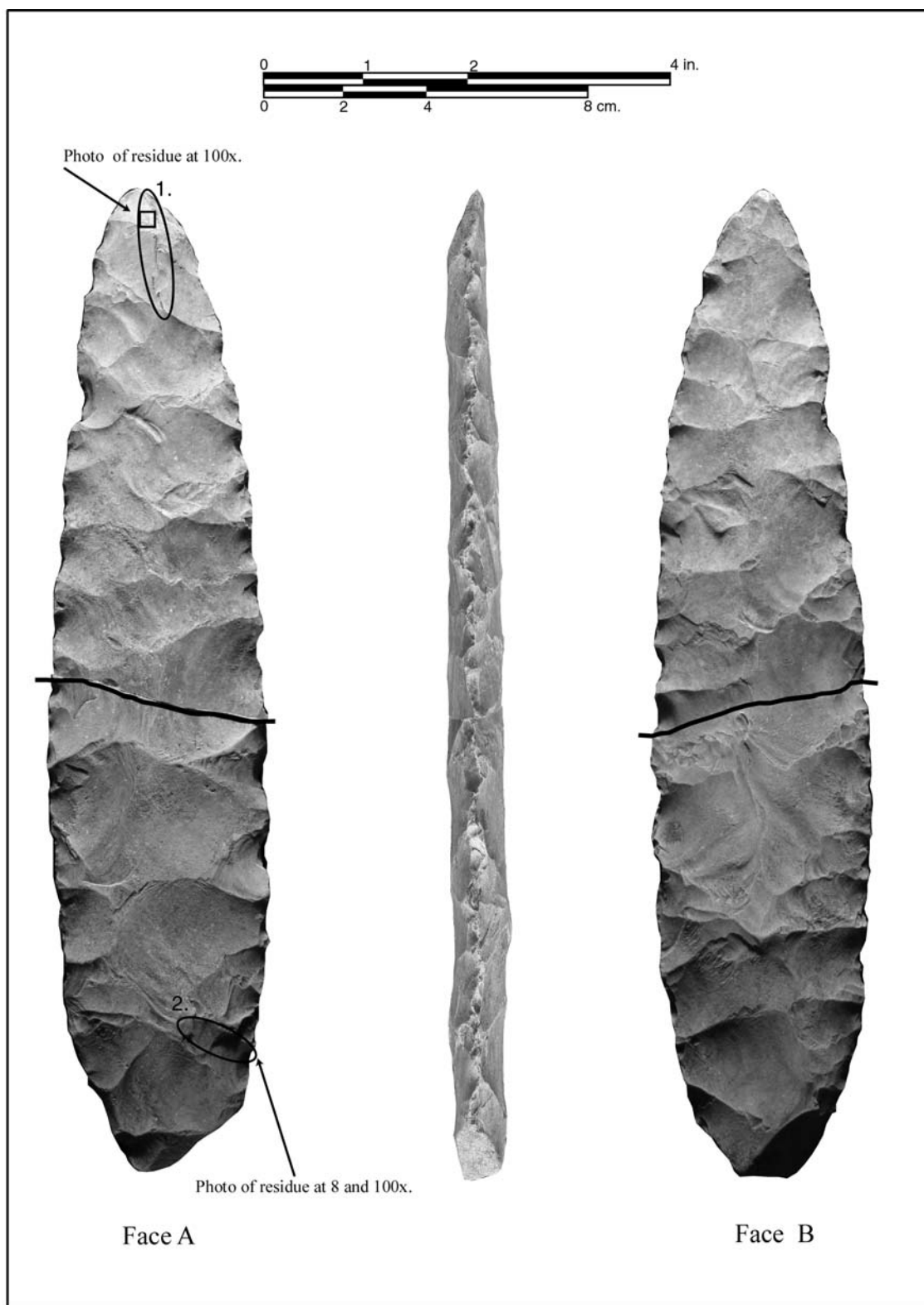
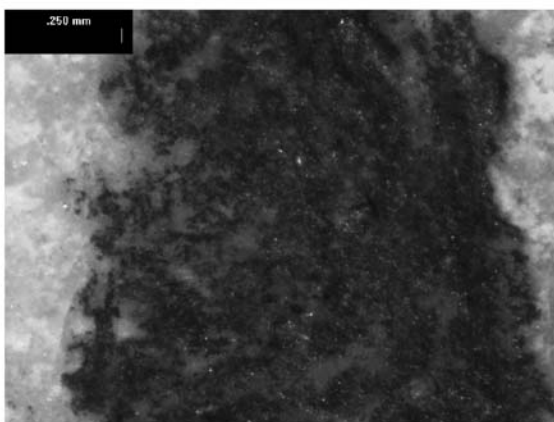
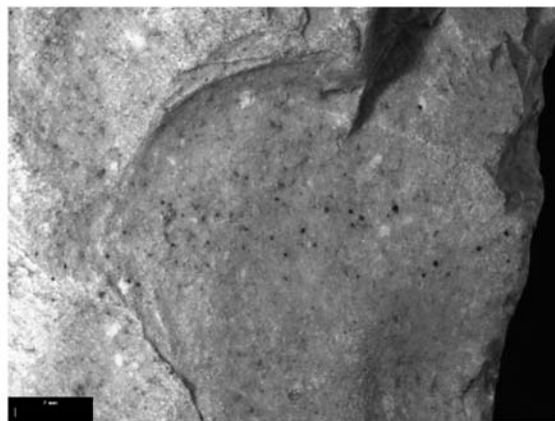


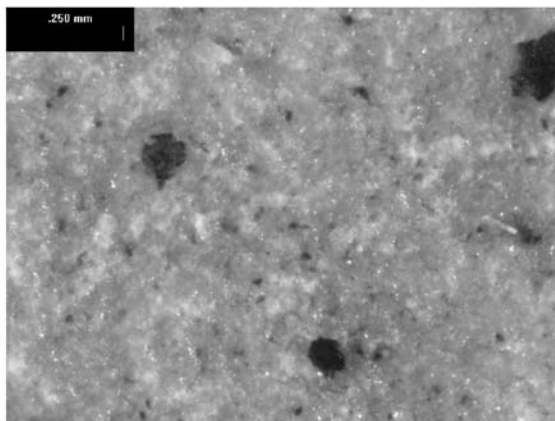
Figure A-11. Biface 11



Residue on tip of Face A 100X



Residue on base of Face A at 8X



Residue on base of Face at 100X

Figure A-11a. Biface 11 Micrographs

**Biface 12**

Dimensions: Length 268 mm, Width 54 mm, Thickness 16 mm, Edge Angle 45° (Figure A-12).

Tip: Heavy patination on both faces. Flake scars are generally shallower and extend only a quarter of the way to the midline of the biface.

Face A: Wide feather-edge thinning flakes dominate the face. Most of the flakes in the midsection of the biface are directly opposite one another forming a weak midline ridge. There are few small flakes between larger thinning flakes.

Face B: Thinning flake scars are not as regular as Face A and there are more smaller flake scars along the edge leaving a less pronounced midline ridge. Patination is more wide spread across Face B than Face A. There are several residue spots across the face (1. at 8X).

Base: Heavily patinated with a more rounded outline than the tip. Flake scars near the base are generally deeper than near the tip.

Edge: Alternating flake scars on either face form a sinuous edge creating platforms and flake arriss to channel future flakes.

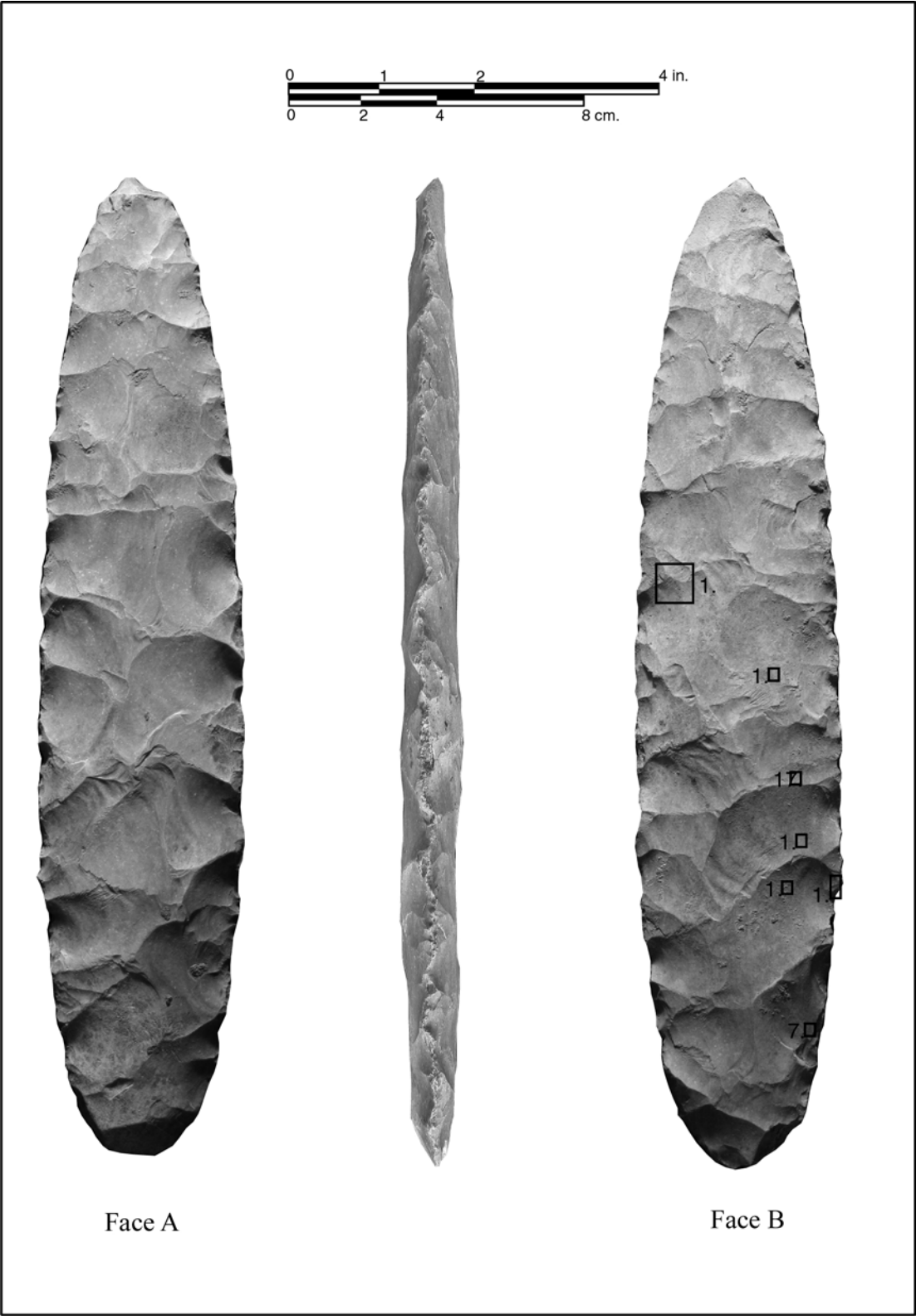


Figure A-12. Biface 12

**Biface 13**

Dimensions: Length 108 mm, Width 56 mm, Thickness 12 mm, Edge Angle 30° (Figure A-13).

Tip: N/A

Face A: This face is dominated by large flake scars with several smaller flakes removed along the edges that only penetrate a few centimeters onto the face. Patination extends from the flake arris into the flake scars. The two scars that form the short edges appear to be caused by a larger biface breaking leaving Biface 13 as the midsection to be retouched along the edges. Only the largest flake scar, that appears to be an overshot flake, was removed before the original biface broke.

Face B: Like many of the other bifaces in the cache, this face has wide thinning flakes from both long edges that meet in the center. More flaking appears on Face B post breaking, than Face A. Patination is more widespread across Face B.

Base: N/A

Edge: There is no obvious difference between the edge on Biface 13 and the other bifaces in the cache; the edge is sinuous with alternating flakes from either face.

General Notes: This is generally a crescent shaped artifact with no tip or base but unlike published crescent artifacts, Biface 13 does not have a concave edge and tips.

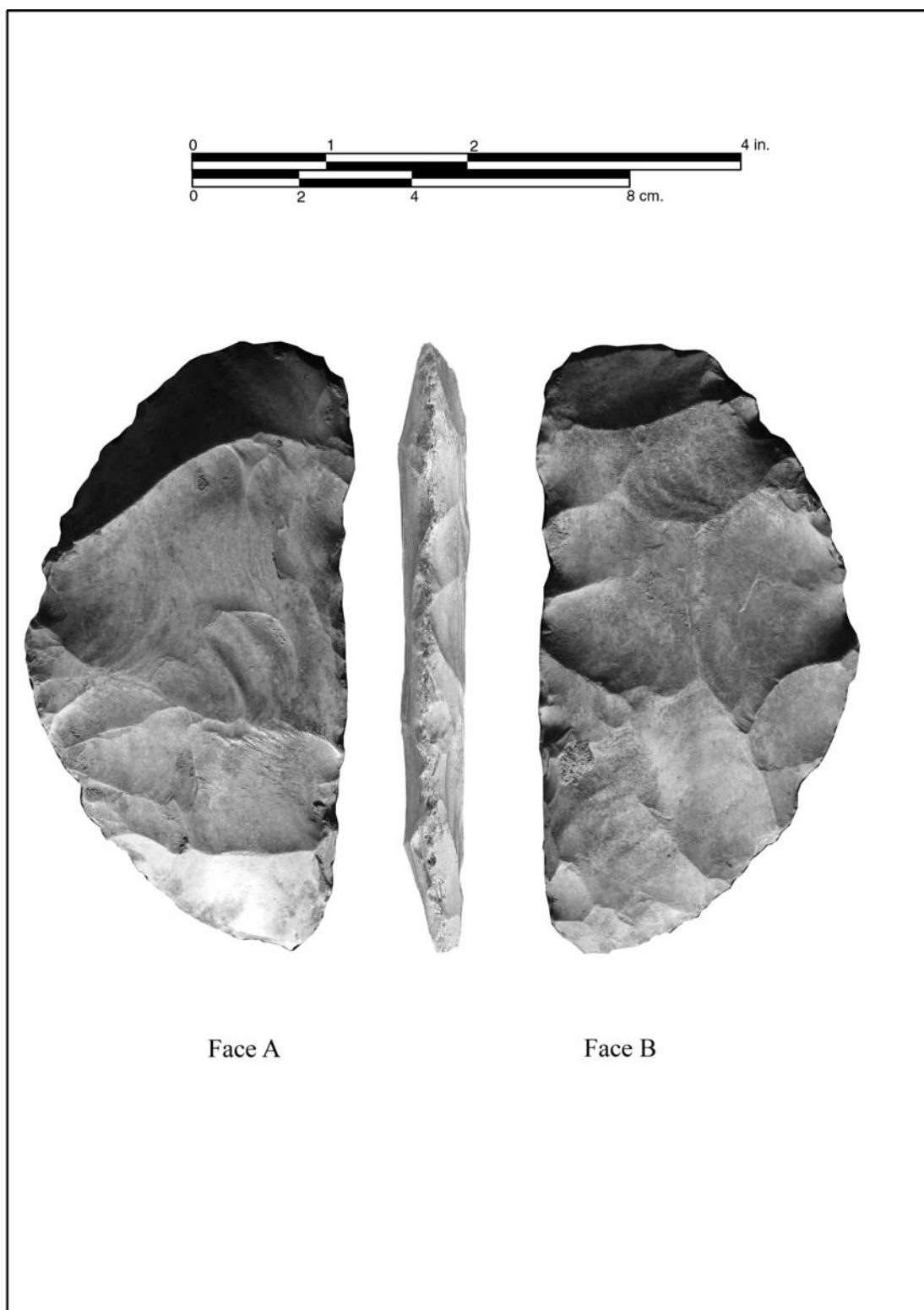


Figure A-13. Biface 13



**Biface 14**

Dimensions: Length 164 mm, Width 56 mm, Thickness 11 mm, Edge Angle 35° (Figure A-14).

Tip: The tip has a rounded outline with large thinning flakes dominating the surface. It is also heavily patinated.

Face A: Large feather edge thinning flakes extend from both edges and meet in a weakly defined midline ridge. The left edge has few smaller flake scars between larger flakes while the right edge has several poorly defined large flakes and more uniformly spaced smaller scars giving a smoother edge outline. Few deep flake scars, most are shallow and extend only a quarter of the way toward the midline.

Face B: Face B has the same flaking pattern as Face A with opposing large thinning flakes meeting in a poorly defined midline ridge. There are few smaller flake scars between and over the larger scars on both edges of Face B.

Base: Rounded outline with few larger scars giving an asymmetrical outline.

Edge: The general line of the edge is straight. Smaller flake scars and general dulling is evident on this biface like every other one in the cache.

General Notes: The entire surface is heavily patinated.

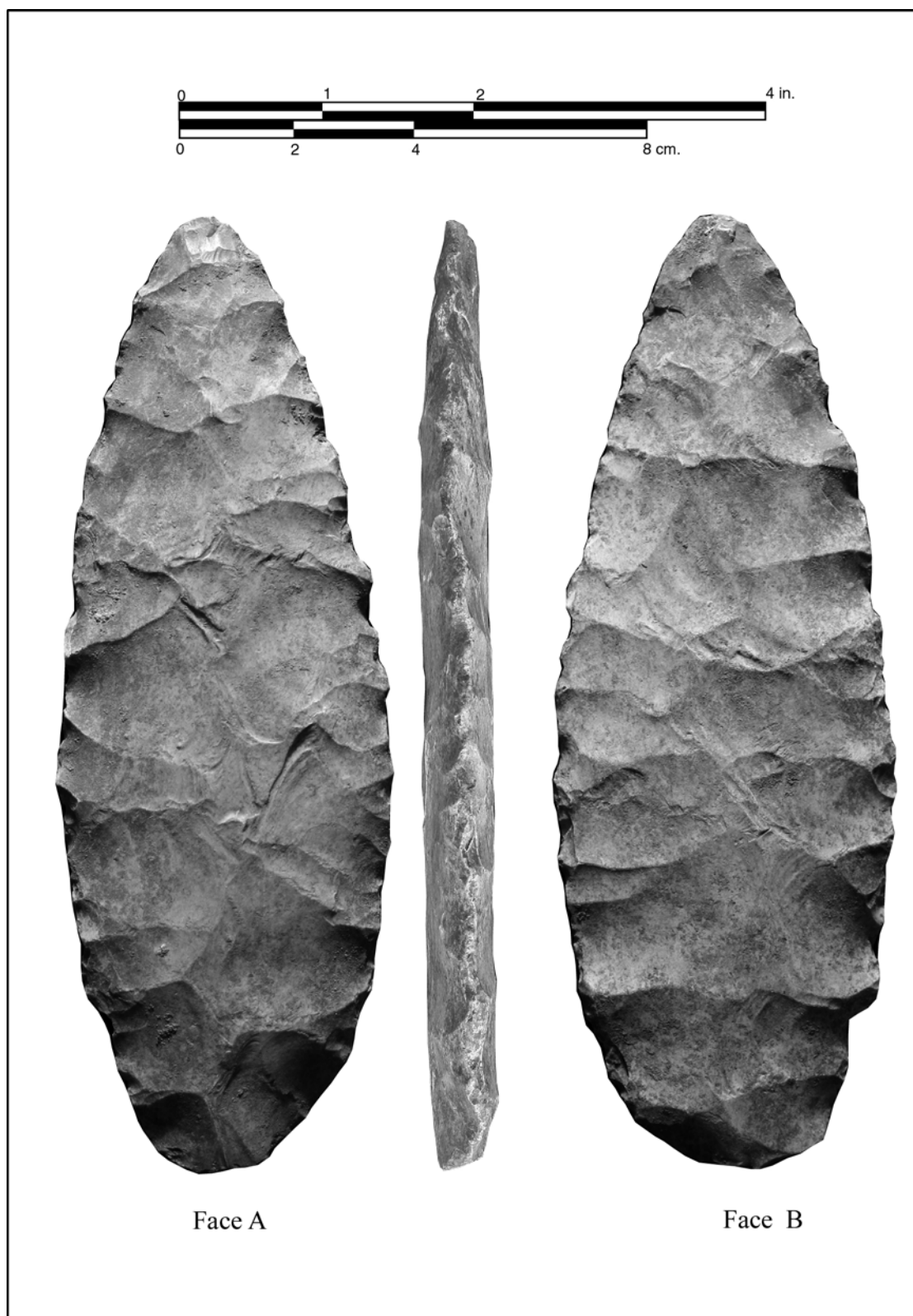


Figure A-14. Biface 14

**Biface 15**

Dimensions: Length 195 mm, Width 53 mm, Thickness 14 mm, Edge Angle 35° (Figure A-15).

Tip: The tip outline is irregular being formed from few large flake scars and skewed to the left edge of Face A.

Face A: Several large feather edge thinning flake scars cross the midline from the left edge. Smaller flake scars from the right edge are directly opposite and form a weak off-center midline ridge. Patination is focused more on the tip than the remainder of the face. There is almost an arc of spots of residue near the base (a.).

Face B: Large flake scars form a weak midline ridge, but several areas along the edge have smaller scars. Patination is heavy on the base of the biface.

Base: Single snap fracture with patination on the surface; this is an old break.

Edge:

General Notes: The irregular outline and dominance of large thinning flake scars suggest thinning and shaping on this biface ended prematurely because it was becoming too narrow. Patination is heavy on both faces but not in similar locations.

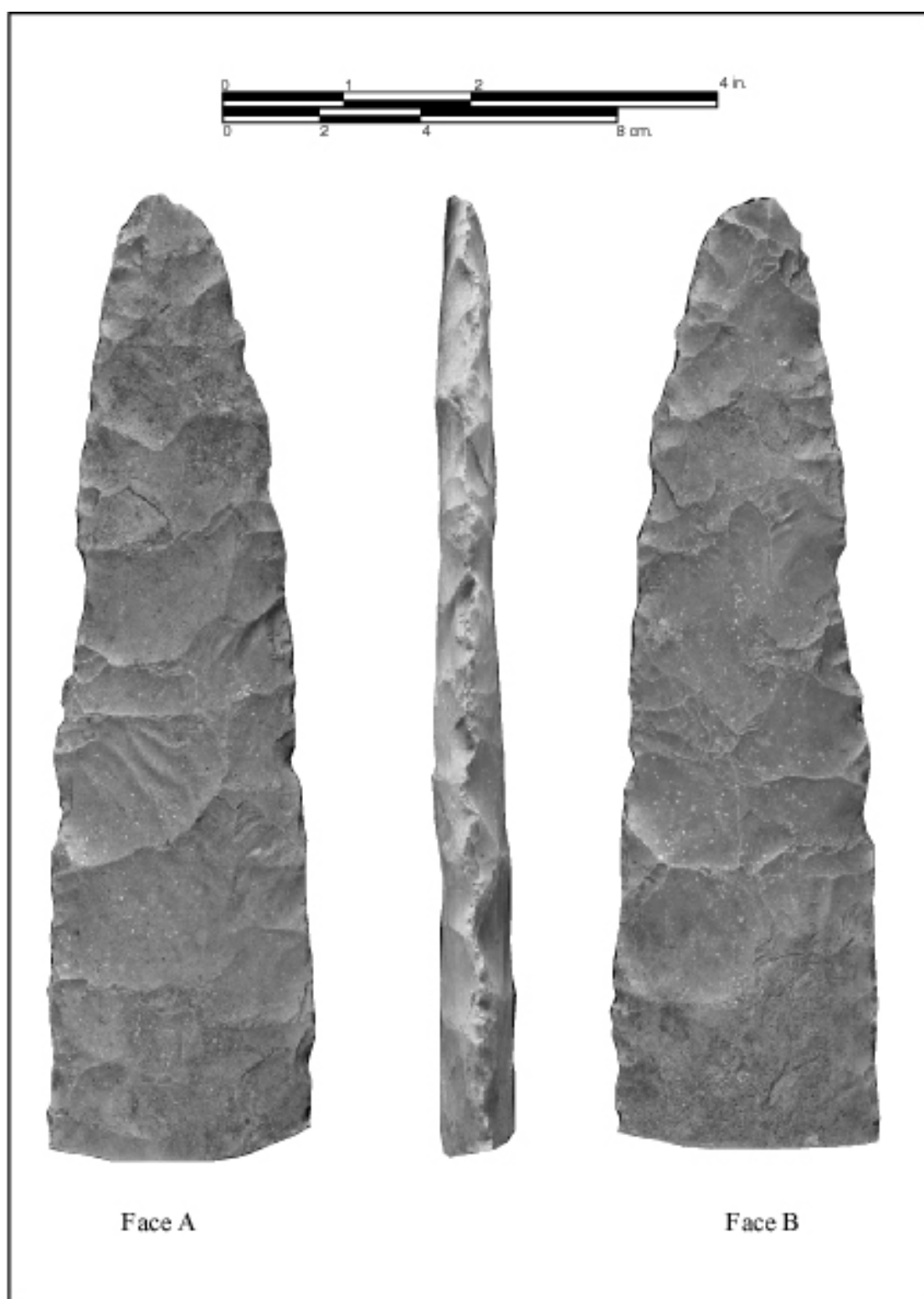


Figure A-15. Biface 15

**Biface 16**

Dimensions: Length 169 mm, Width 58 mm, Thickness 16 mm, Edge Angle 40° (Figure A-16).

Tip: The tip has a few large flakes across the surface. Patination covers the surface of both faces and cortex present on Face A.

Face A: Large patch of cortex covers one-third of the face and tip. The face is dominated by large flake scars that terminate at the Cortex patch. The largest flakes extend from the left edge to the cortex patch and the shorter flakes extend from the right edge toward the cortex. Four of the right edge flakes are under the cortex. The large flake scars give the biface an irregular outline.

Face B: This face is an almost mirror copy of Face A with large flake scars extending from the right edge and shorter flakes on the left edge. The obverse flake pattern places the midline ridge to the left of center. Cortex on tip and in three isolated patches on the face at peaks created by flake scars that failed to remove the cortex. Patination still covers the remainder of the face (1. at 10X) with isolated polish in flake scars on top of patination (2. at 20X).

Base: The base has only a few large flakes. Only a small amount of cortex on the base. The base is thinner than the tip in profile.

Edge: Both edges are sinuous caused by flakes on alternating faces.

General Notes: Large thinning flakes with few smaller flakes to make the edge uniform and cortex on the faces suggest this biface is early in reduction. All of the large flakes were removed from the same edge moving the midline ridge toward the same edge on both faces. Cortex on tip and base. Patination on both faces.

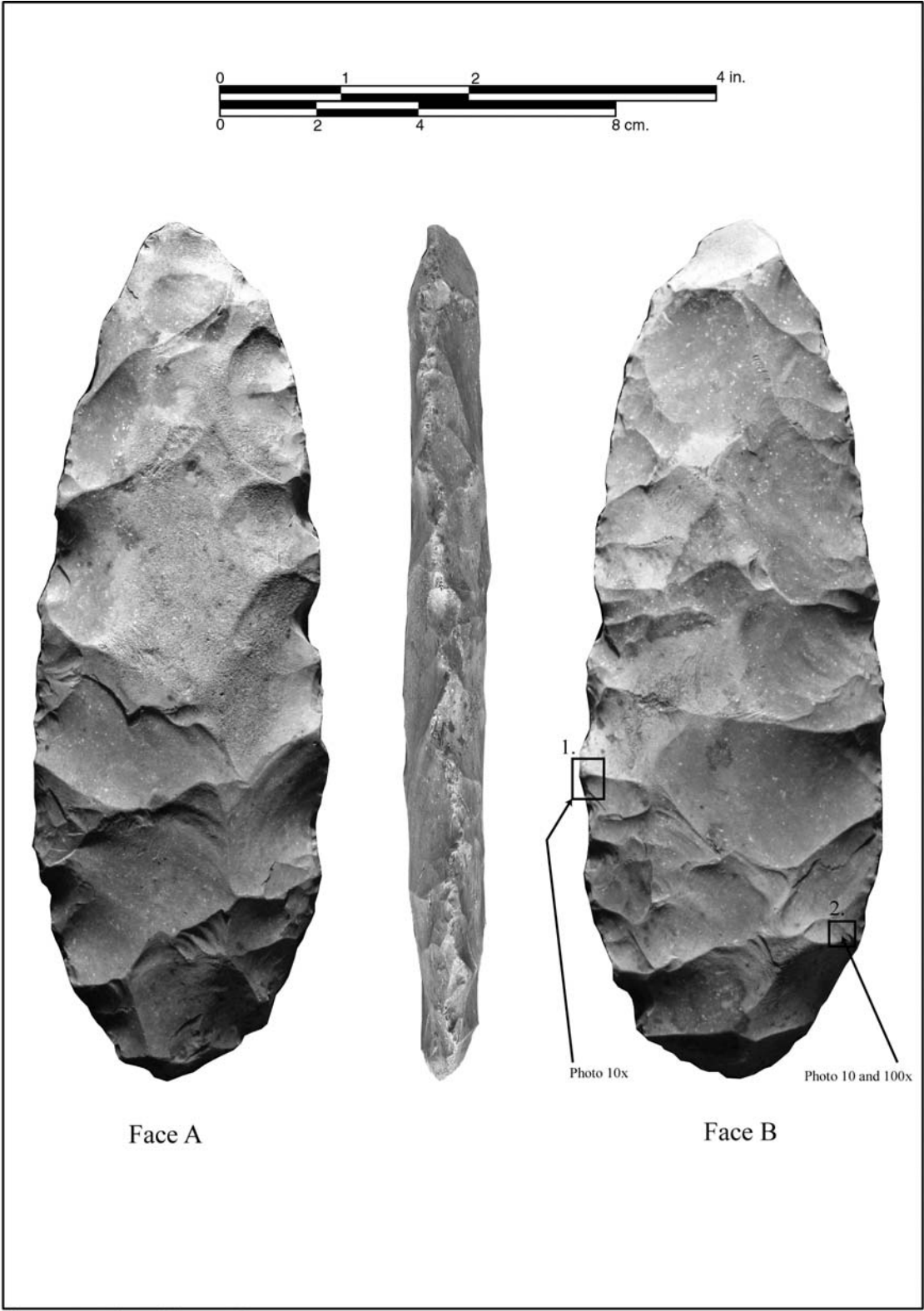
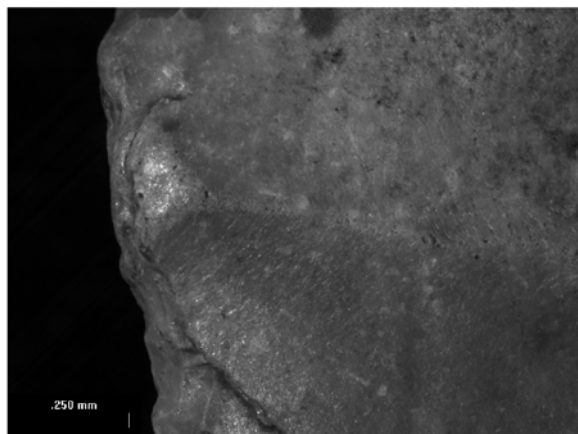
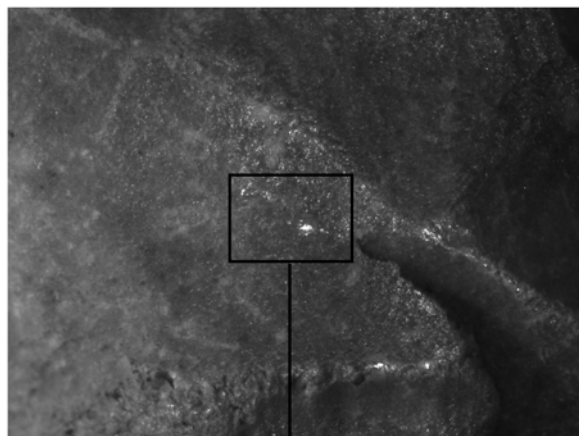


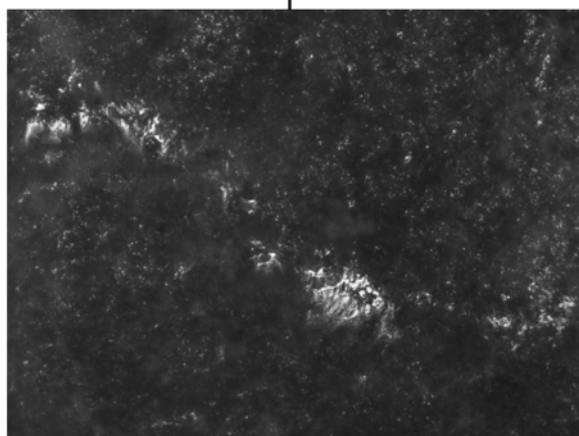
Figure A-16. Biface 16



1. at 10X



2. at 10X



2. at 100X

Figure A-16a. Biface 16

**Biface 17**

Dimensions: Length 290 mm, Width 59 mm, Thickness 16 mm, Edge Angle 45° (Figure A-17).

Tip: The tip is indistinguishable from the base; neither the outlines or the cross-sections are different ton include a short, deep flake on the tip of Face B and a short deep flake on the base of Face A. Patination is heavy on the tip.

Face A: The face is dominated by large feather-edge thinning flakes equally from both edges. These flakes form a well defined midline ridge. Smaller flakes separate the larger scars and maintain an even outline. Patination is most evident along arrises.

Residue (4.) is associated with a recent steep flake in the right edge of Face A.

Face B: The flaking pattern on Face B is the same as Face A with opposing feather edge flakes forming a midline ridge and smaller flakes making a uniform outline. There are several small areas of residue across the face (4. photos at 16 and 100X) and isolated polish (2. photo at 100X) (Figure A-17a).

Base: Like the tip, a short deep flake was removed from the end. Patination is present to one side.

Edge: Left edge of Face A is sinuous while right edge has a straighter segment where flakes are removed directly opposite one another instead of off center.

General Notes: Several large flakes were removed on both faces. Residue dominates Face B. Patches of residue have arrows showing orientation while spots of residue have circles.



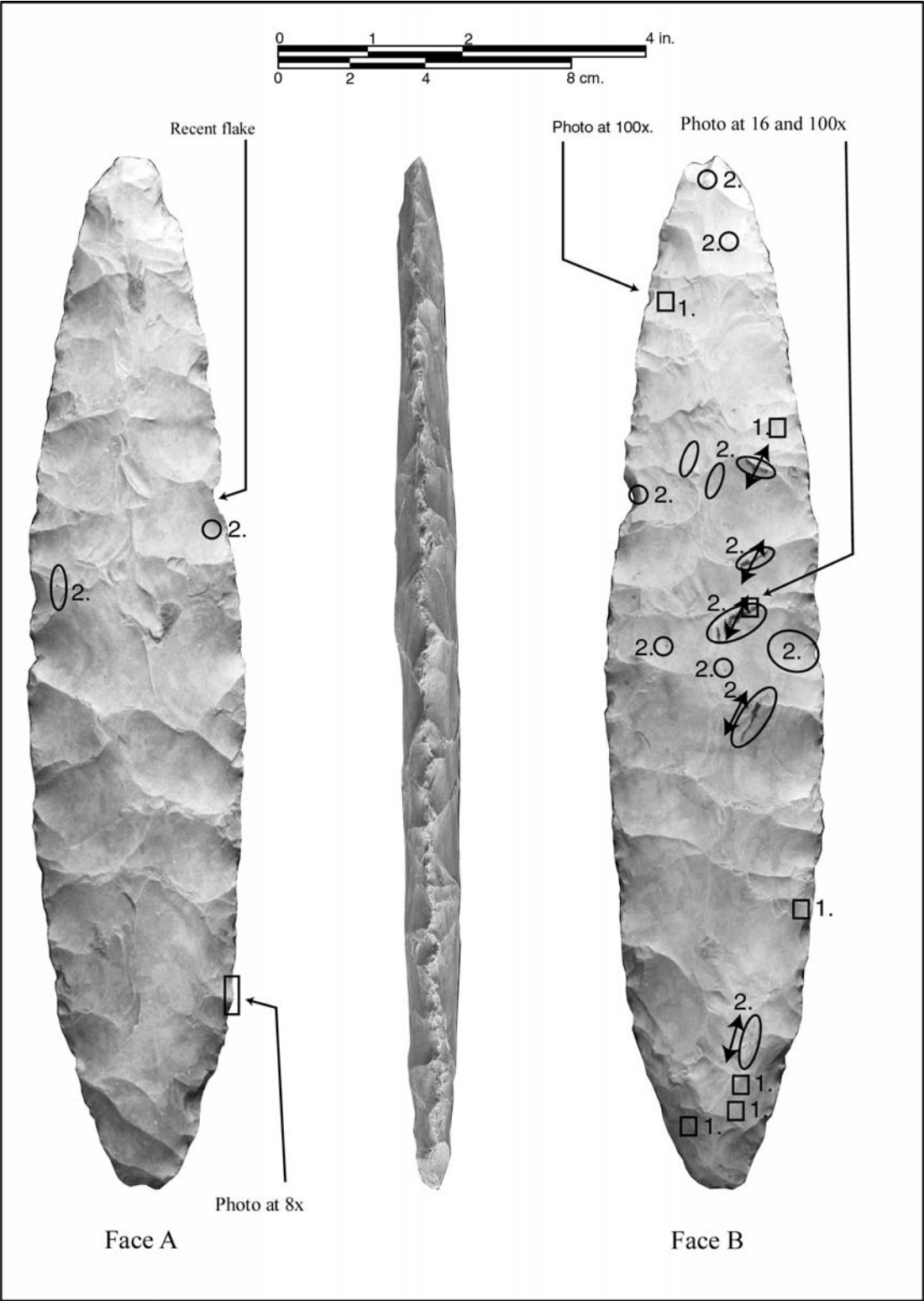


Figure A-17. Biface 17

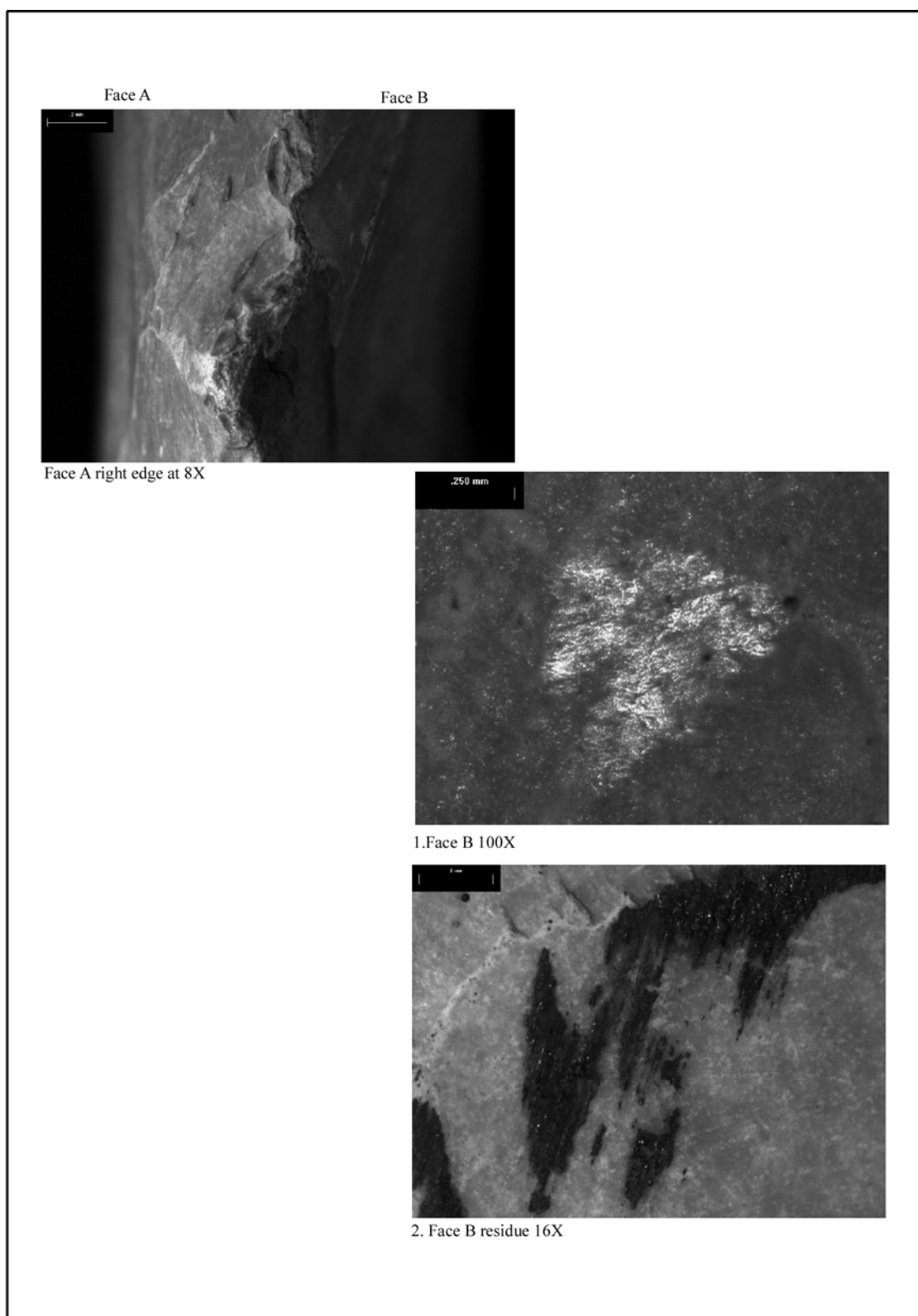


Figure A-17a. Biface 17

**Biface 18**

Dimensions: Length 241 mm, Width 48 mm, Thickness 12 mm, Edge Angle 40° (Figure A-18).

Tip: Flake size reduces toward the tip keeping the midline ridge almost all the way to the edge. Heavy patination on tip and left edge of Face A. Directional residue along the midline ridge of Face B.

Face A: Large feather edge thinning flakes dominate the surface from both edges and meet to form a midline ridge. Steeper flake scars separate the thinning flakes and smooth the biface outline. Spots of residue near the tip create a line perpendicular to the directional residue on Face B (1.).

Face B: The surface is predominantly large thinning flakes separated by smaller flakes. The right edge of Face B has several small steep flake scars along the edge Residue (1.)

Base: The base is tilted toward the right edge of Face A and has heavy patination. This may be the original flake platform for the biface.

Edge: Sinuous with alternating flake scars on opposite faces.

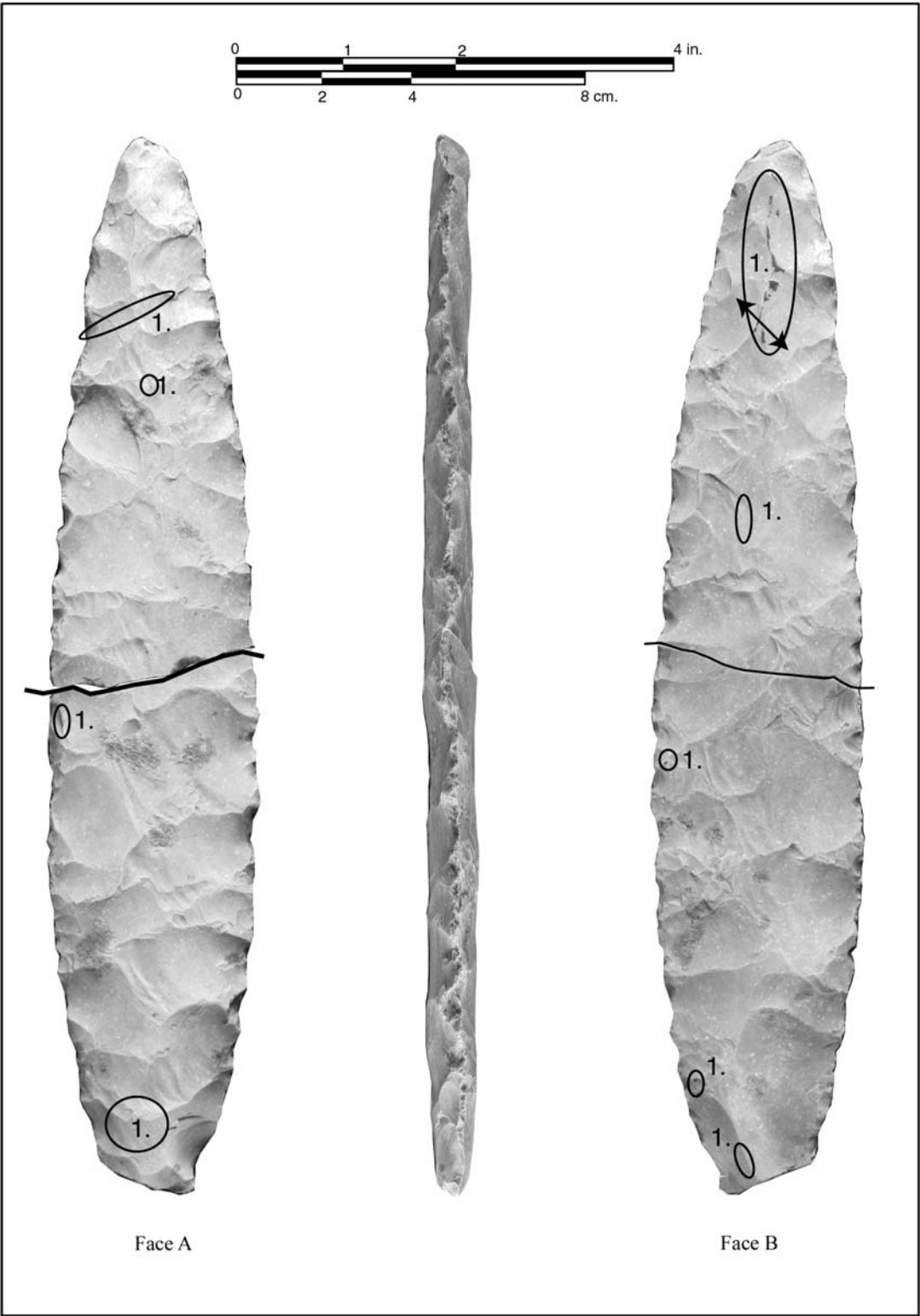


Figure A-18. Biface 18

**Biface 19**

Dimensions: Length 174 mm, Width 55 mm, Thickness 14 mm, Edge Angle 40° (Figure A-19).

Tip: On Face A there are few large flakes while Face B has smaller flakes. Patination is present on all surfaces.

Face A: One overshoot flake crosses the biface from the right edge to the left near the tip. All other large thinning flakes meet near the midline. Few smaller flakes separate the larger thinning flakes. The left edge is slightly recurve while the right edge is convex. Spots of residue form two lines (1.).

Face B: Large feather edge thinning flakes extend from both edges to form a midline ridge. Few smaller flakes separate the larger thinning flakes.

Base: Like Biface 18, Biface19 has a tilted based with heavy patination. Like the other bifaces, this may represent the original flaking platform. The uniform thickness of this bifaces may also attest to the thickness of the ledge or the size of the cobble used in making these bifaces.

Edge: Relatively straight.

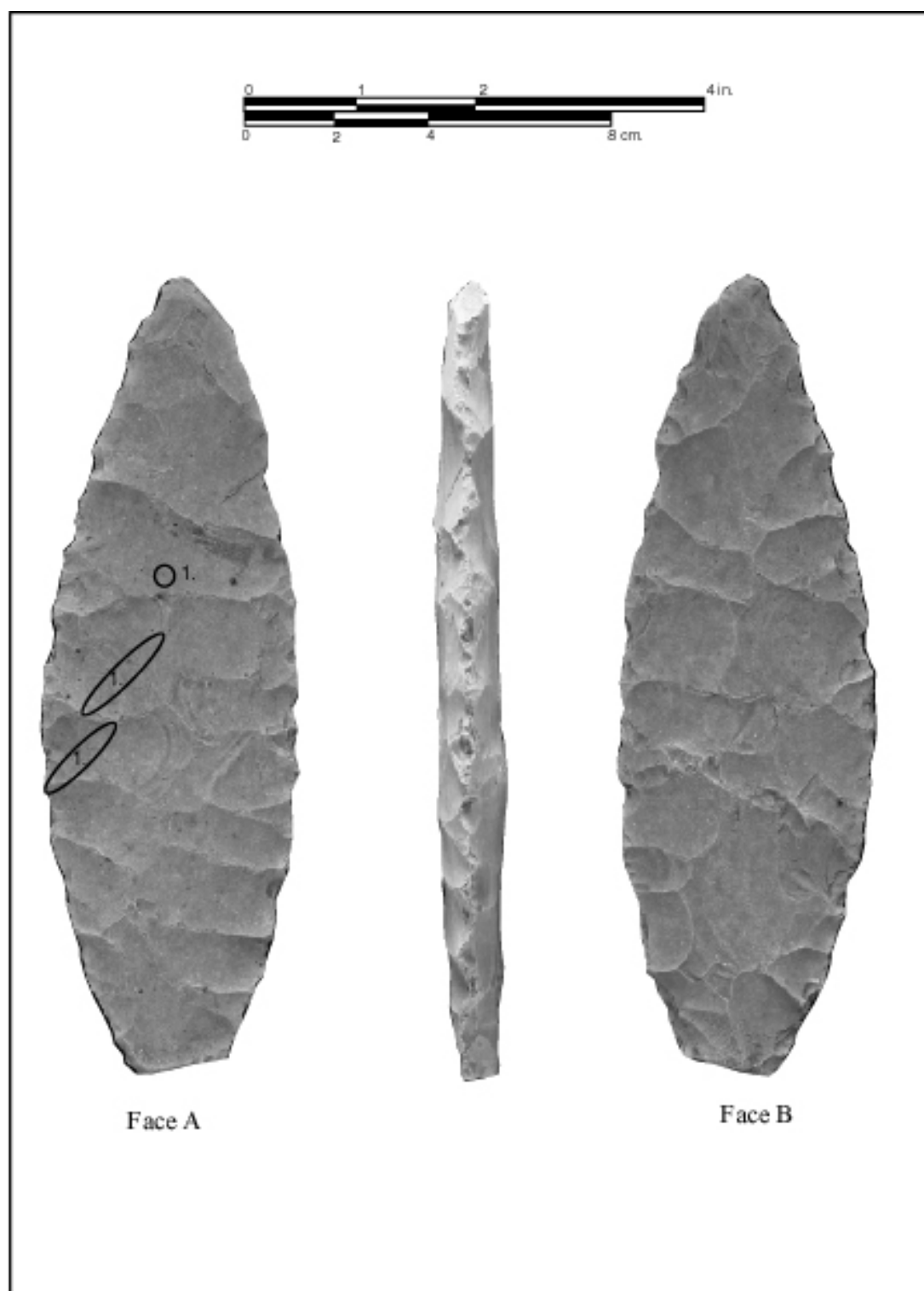


Figure A-19. Biface 19

**Biface 20**

Dimensions: Length 180 mm, Width 58 mm, Thickness 14 mm, Edge Angle 45° (Figure A-20).

Tip: Large flake scars dominate both faces; however, the right edge of Face A and the corresponding left edge of Face B have more smaller scars making a diffuse edge line.

Face A: Large feather edge thinning flakes dominate the surface extending from both edges past the midline. The left edge of Face A has a more curved convex shape than the right edge suggesting a knife with one modified edge, but no evidence was found of substantially more or fewer flakes scars on one edge or the other. Two areas have fresh impacts and residue (1.) and the biface is broken at the impact near the base. Scattered residue is obvious in other locations (2.).

Face B: Like Face A, large flake scars extend beyond the midline leaving a weak ridge. Few smaller flakes separate the larger thinning flakes.

Base: The base is a continuation of the edges with large flake scars. It is separated from the remainder of the biface by an impact and subsequent break of the biface.

Edge: Most of the edge is sinuous with flake scars on alternating faces. Near the tip the edge is more straight.

General Notes: Most of the large flake scars terminate near the centerline or cross over slightly. Patination is present on all flake arrises on both faces.

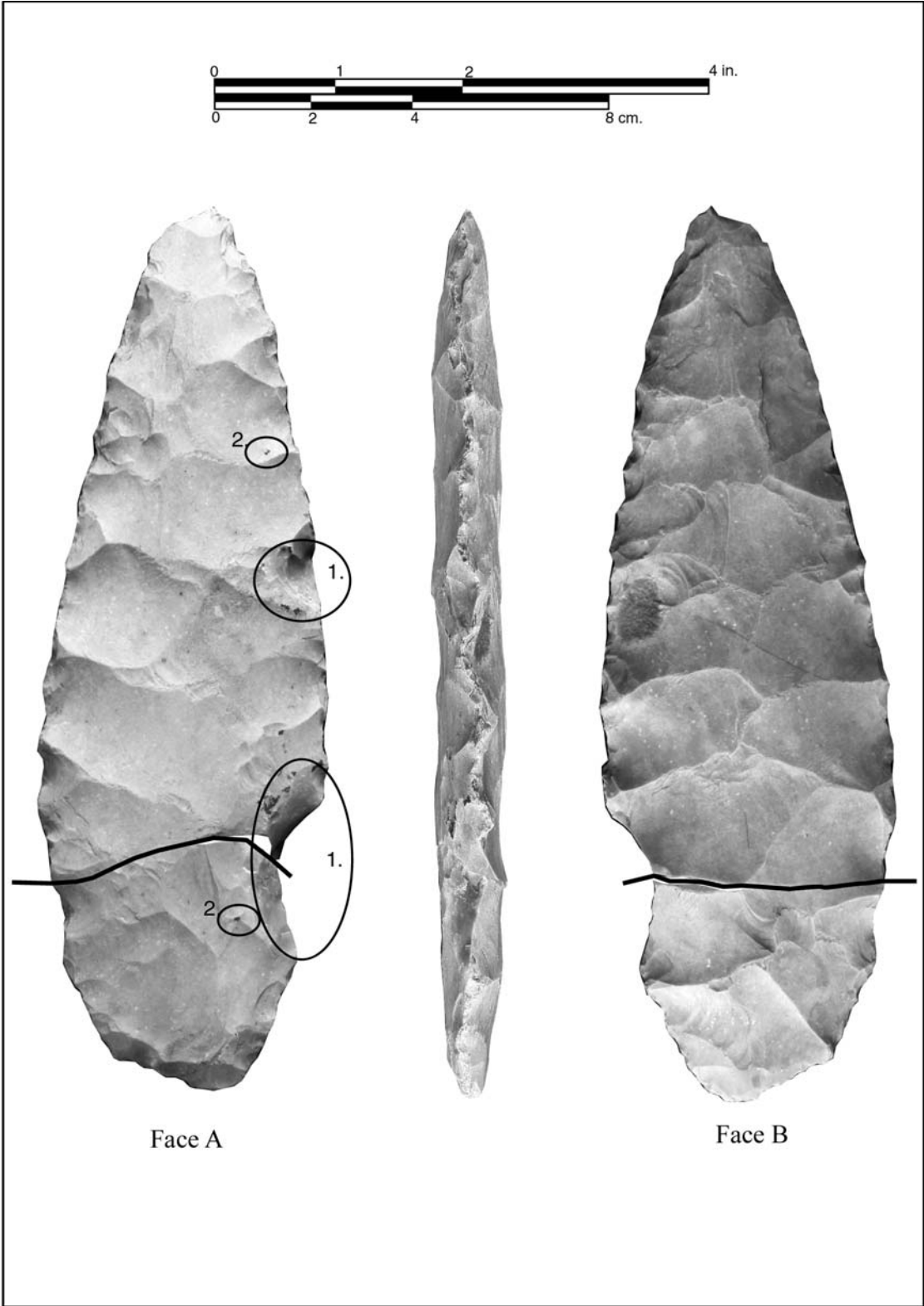


Figure A-20. Biface 20



**Biface 21**

Dimensions: Length 156 mm, Width 49 mm, Thickness 14 mm, Edge Angle 35° (Figure A-21).

Tip: The tip is flat with Cortex on the tip and penetrates roughly 3 mm into the biface.

Face A: Patination is most obvious along flake arrises but extends over the entire face.

Large feather edge thinning flakes extend from the edges toward the midline. Few small steeper flakes are visible along the edge. The outline is irregular along the left edge.

Each of the indentions into the edge as several smaller flake scars. No residue was found near the outline indentions.

Face B: Patination is present along flake arrises over entire face. Large feather edge flake scars extend toward the midline but there are several other flake scars from earlier reduction that obscure the midline ridge.

Base: There is a single flake scar on the end that extends up the left edge of Face A and right edge of Face B. The opposite edge is more uniform with smaller flake scars.

Edge: The thinning flake scars are not offset on opposite faces; therefore, the edge is straighter. Breaks occur along the edge on the right edge of Face A (shown) where indentions occur along the edge. An area of cortex extends for 76 mm along the base section of edge

General Notes: The biface is broken in the middle and a wedge is missing. No residue was visible to associate the break with metal blade excavation. Isolated remnants from earlier reduction stages are evident on both faces; small deep flake scars with no visible negative bulbs of percussion. This is the largest biface of the collection at over 30 cm long and it still came from a ledge thicker or a boulder larger than 30 cm.

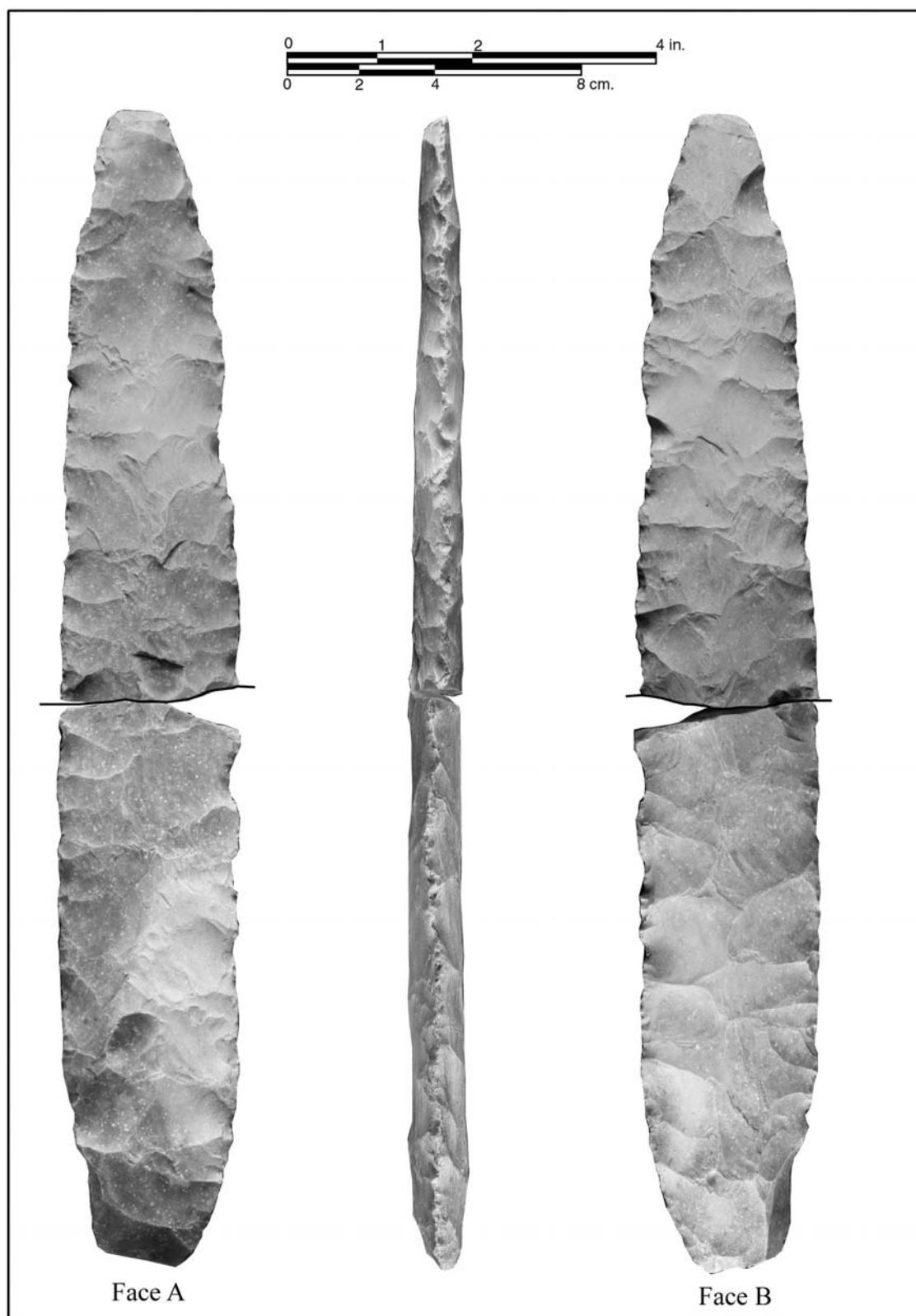


Figure A-21. Biface 21

## **Biface 22**

Dimensions: Length 279 mm, Width 61 mm, Thickness 15 mm, Edge Angle 45° (Figure A-22).

Tip: The tip is formed with a few large flake scars that extend across the face

Face A: Large feather edge thinning flakes extend across the midline from both edges. These flakes form a weak midline ridge. Patination dominates the basal fragment and there are three recent step fractures along the left edge including the break between the base and midsection (1.) (Figure A-22a). The right edge has several small hinge and step fractures. The entire Face A has scattered directional residue in patches (2.).

Face B: Like Face A, Face B has several large thinning flakes that extend past the midline leaving a weak ridge. Few smaller flakes are present on the face. Patination is prevalent over the entire face, but there is significantly less residue than Face A.

Residue is present, but it is scattered in a diagonal line across the midsection (a.).

Base: Large flakes dominate the faces with little difference from the remainder of the biface.

Edge: The edge is straight with several small hinge/step fractures except where a thinning flake has broken the edge making it off center and sharper.

General Notes: Patination is on arrises and within flake scars of both faces.

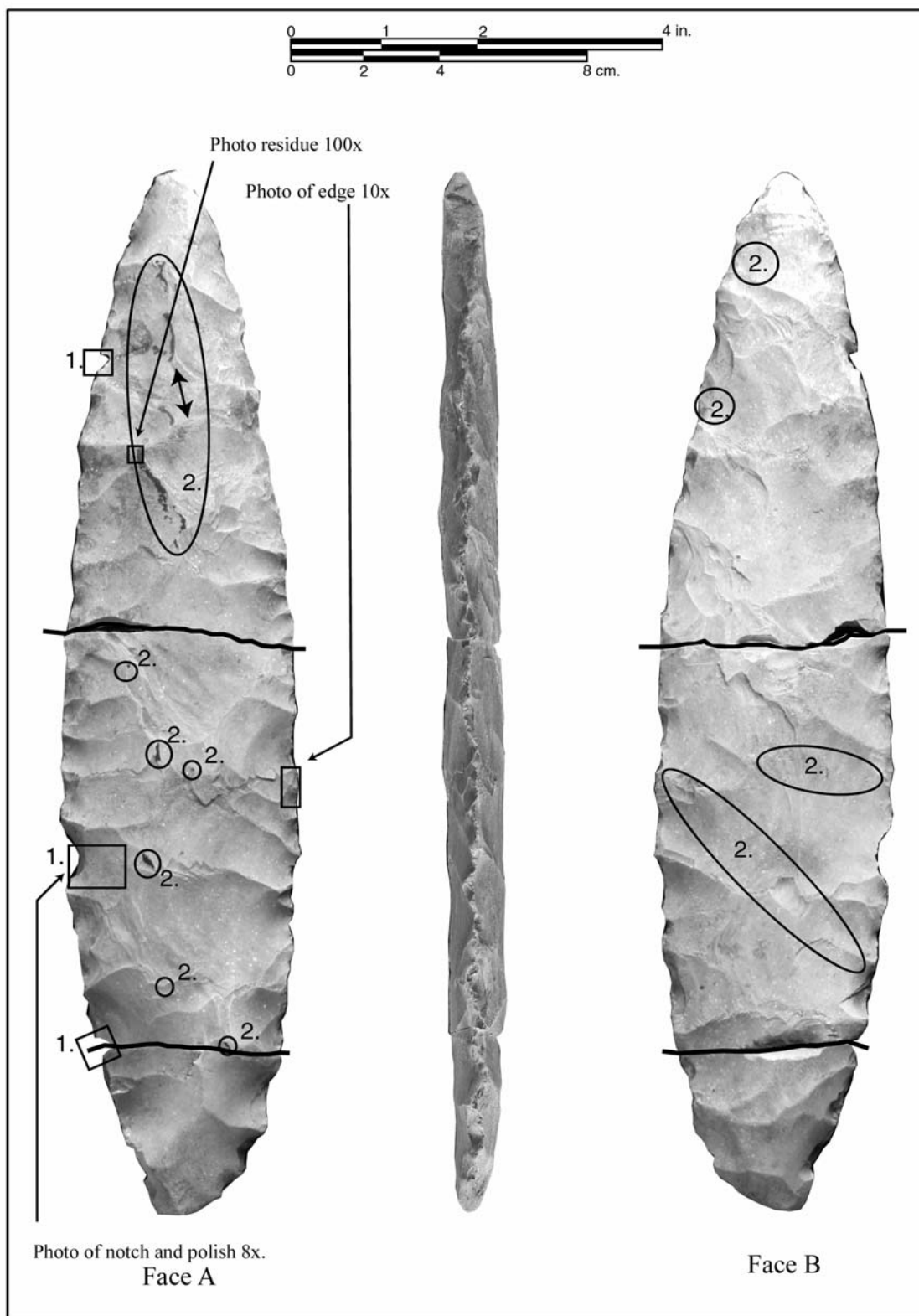


Figure A-22 Biface 22

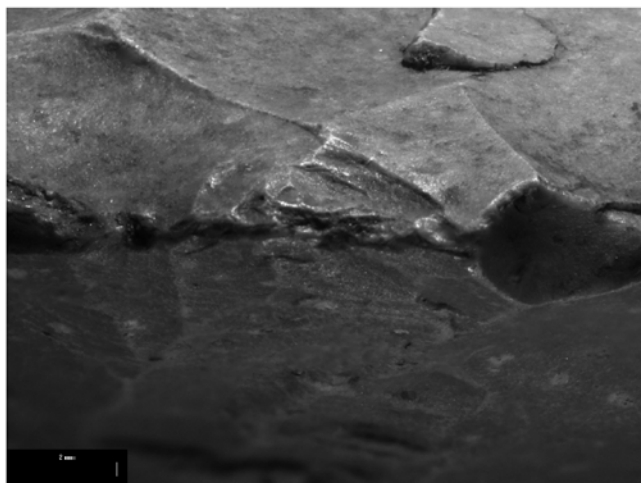


Photo of edge at 10X

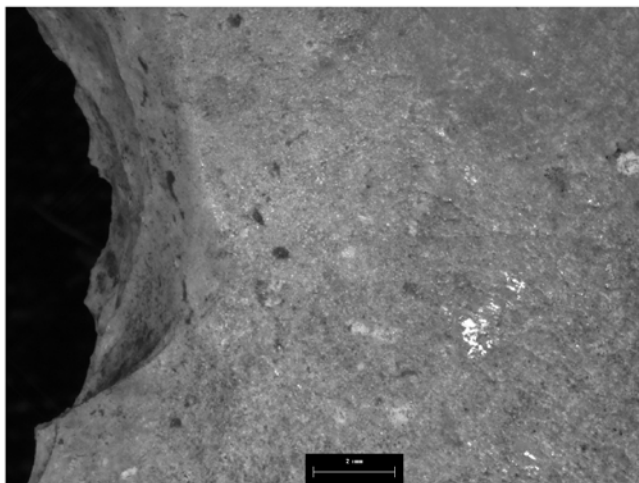


Photo of notch and polish at 8X

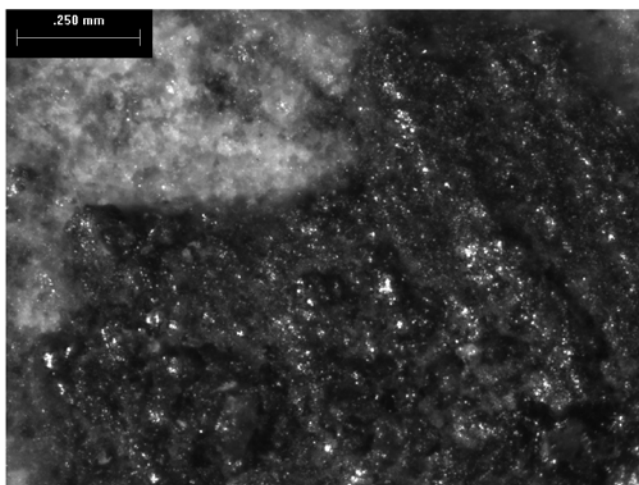


Photo of residue at 100X

Figure A-22 Biface 22 Microphotographs

**Biface 23**

Dimensions: Length 185 mm, Width 51 mm, Thickness 13 mm, Edge Angle 40° (Figure A-23a).

Tip: The tip has increasingly smaller flakes toward the tip. Larger and later flakes were both removed from the right edge of either face near the tip.

Face A: Large thinning flakes extend past the midline leaving a weak ridge. There is little patination overall, but flake arrises have the most. There is some directional residue in the central portion of the lower half (1.).

Face B: Face B is similar to Face A with large thinning flakes extending across the midline. There is heavy patination over the entire surface. Residue is present but significantly less abundant.

Base: Flake size does not change between the base and the remainder of the biface. The base has cortex on the edge and may be part of the original flake platform for the biface.

Edge: Large thinning flakes are offset on either face causing a sinuous edge. Few smaller fractures were observed along the edge and heavy patination is present.

General Notes: The fracture was caused by the box blade. Many of the flake scars are deep and wide. Photo of fresh break to show edge angle and variation in patination; upper surface is Face B.

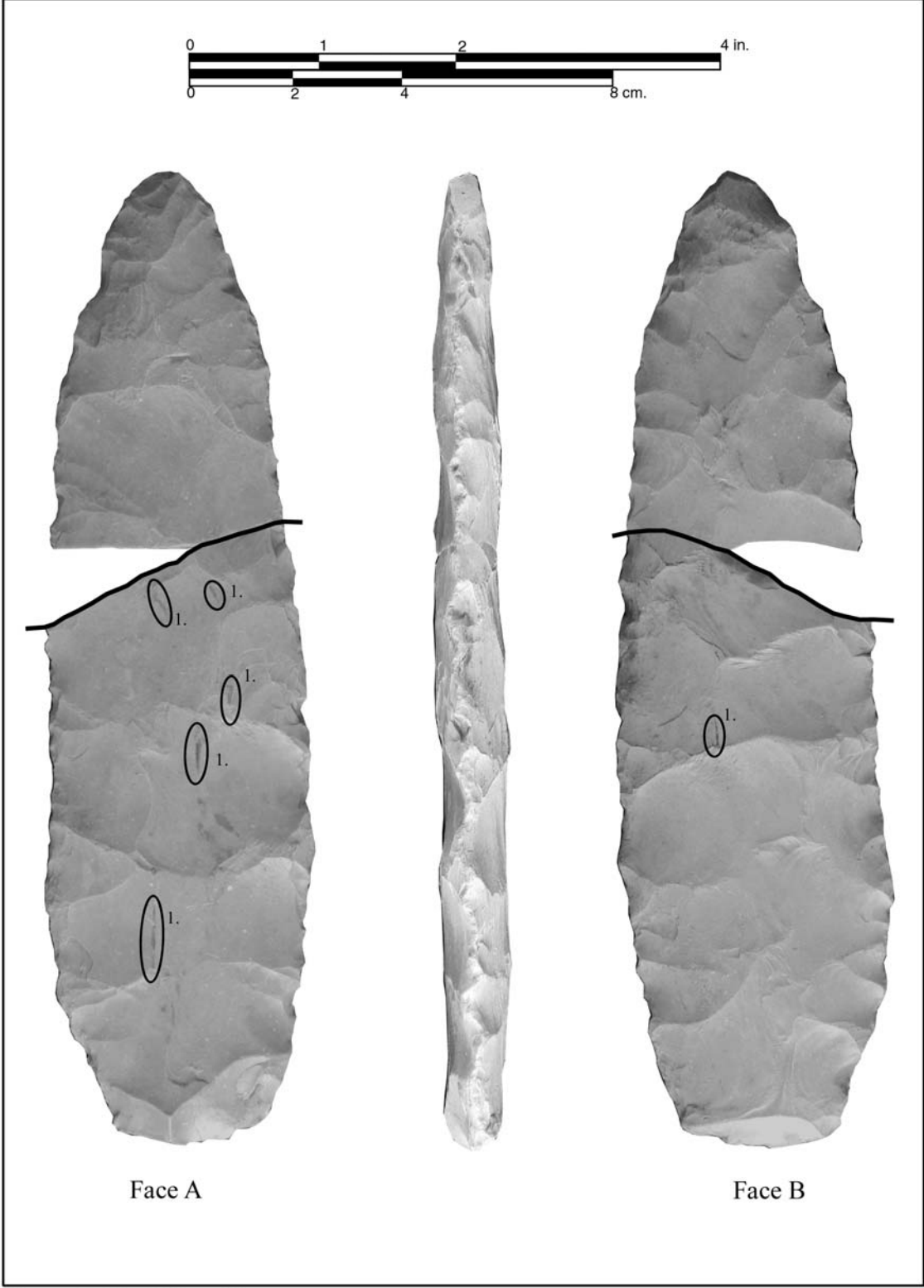


Figure A-23. Biface 23

**Biface 24**

Dimensions: Length 216 mm, Width 49 mm, Thickness 15 mm, Edge Angle 40° (Figure A-24).

Tip: Flake patterns varie between Face A, with smaller flakes that meet at a central point, while Face B has several large flakes. Overall the tip has rounded outline.

Face A: Several large thinning flakes extend from both edges toward the midline forming a strong ridge. The outline is irregular with indentions occurring at large flake originations. Patination is evident on flake arrises with lesser amounts within flake scars.

Face B: Face B is similar to Face A with large feather-edge thinning flake scars and irregular outline caused by the thinning flakes. Patination is more evident than on Face A.

Base: Flake scars on the base are a similar size to the remainder of the biface. Slightly thinner in cross-section than remainder of biface, but still thicker than tip.

Edge: The edge is sinuous with offset thinning flakes on either face.

General note: The more irregular outline is attributed to several large and deep flake scars near the middle of the biface.



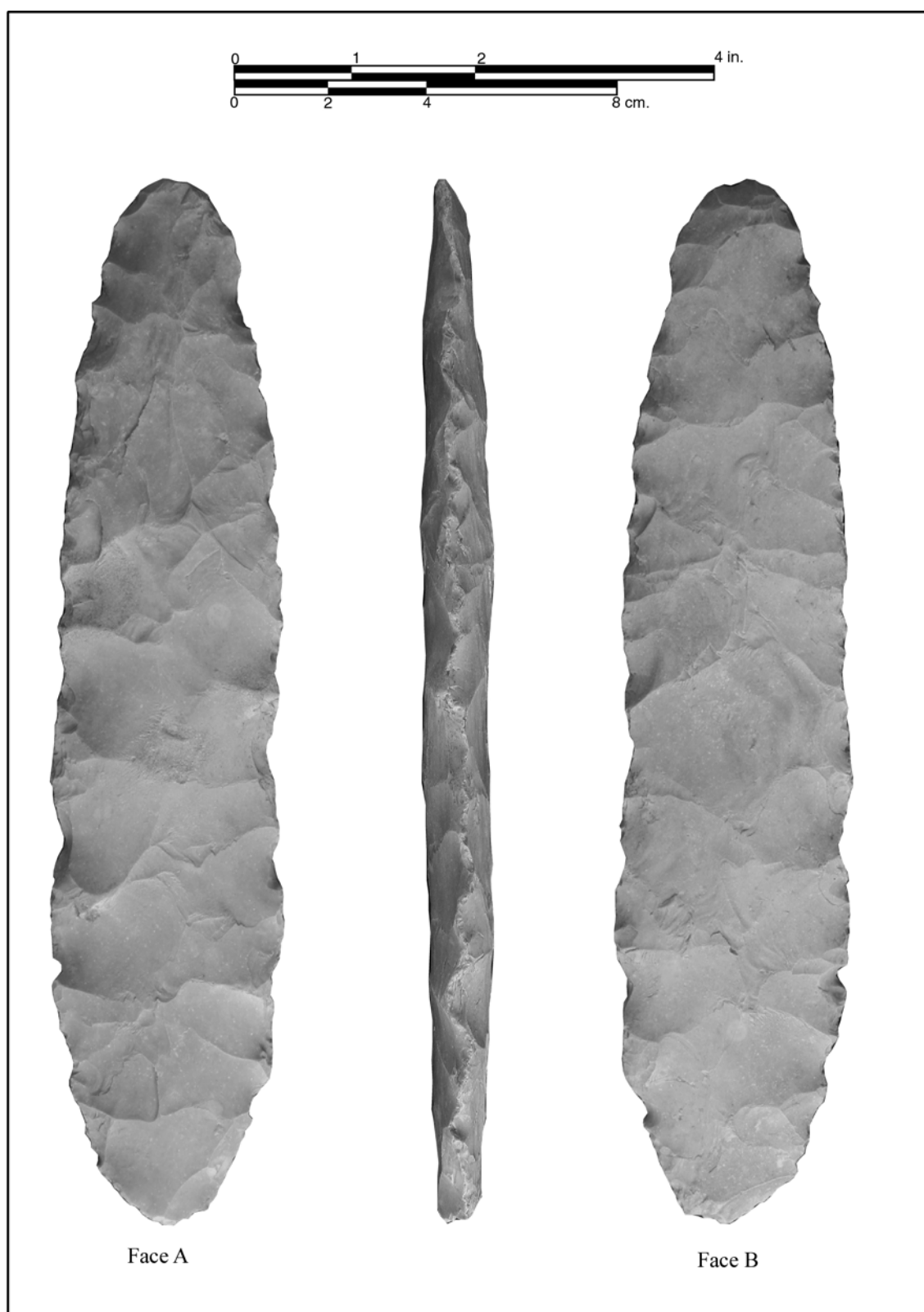


Figure A-24. Biface 24

**Biface 25**

Dimensions: Length 167 mm, Width 59 mm, Thickness 15 mm, Edge Angle 35° (Figure A-25).

Tip: The tip is thinner than remainder of biface, although flake scars do not change much in size. The large flake scars and thinner cross-section may have caused or increased the chance the tip would break where it did.

Face A: There is light patination overall, with most along the flake arrises. Some cortex is present along edges. The largest thinning flakes initiate from the left side of Face A and extends slightly over the midline. Smaller feather-edge flakes separated the large flake scars on the left edge. The right edge has shorter flake scars that are more uniform and without intervening small flake scars.

Face B: The entire surface is covered with a thick cortex that has either formed since flaking the biface or the flake blank used for the biface was near the natural surface of the source material and the flakes were quickly eroded by the remaining porous surface. The right edge and base may be the only portion of Face B that removed the cortex completely, but this area quickly weathered. Flake scars from both edges terminate near the midline of the biface.

Base: rounded outline, but a deep flake scar on Face A dominates the base. This is similar to end thinning in Clovis bifaces before the base is finished.

Edge: Heavily patinated and post knapping cortex is abundant. The flake scars create a uniform sinuous edge that is off center.

General Notes: The patination and cortex dominates Face B but appears only near the edges, tip, and base of Face A. Patination/cortex is most prevalent along the tip, left edge of Face B, and center ending approximately 1/3 the length of the biface from the base.

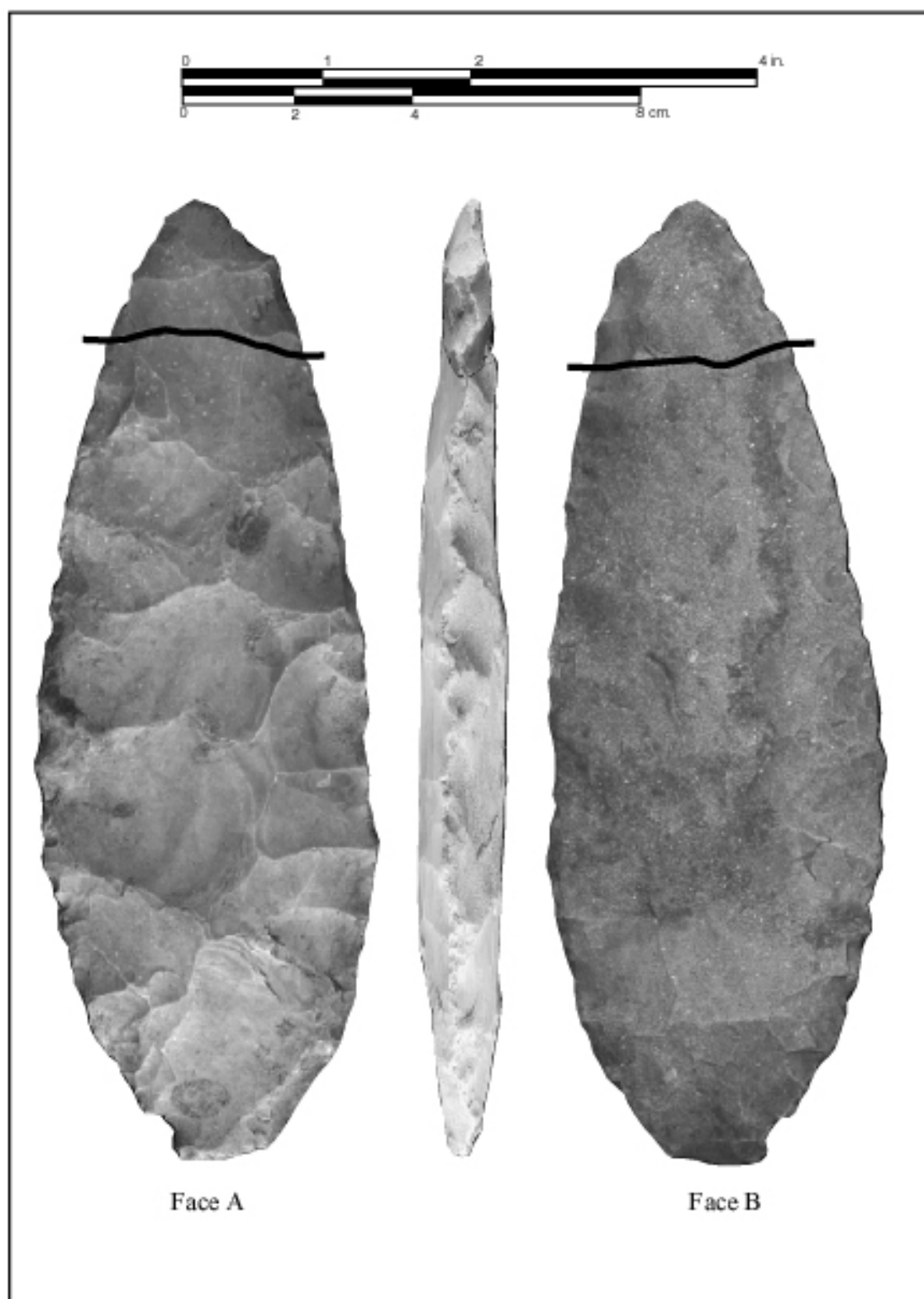


Figure A-25. Biface 25

**Biface 26**

Dimensions: Length 118 mm, Width 58 mm, Thickness 17 mm, Edge Angle 35°.

Tip: The tip is missing. The biface as a single snap fracture appears to have removed 1/3 of the tip.

Face A: Large feather-edged flake scars terminate near the midline forming a weak central ridge. Three larger flake initiations are separated by smaller feather-edge terminated flakes, the other large flakes have a single arris between them. Patchy metal polish and other residues from Mr. Hegar's truck. Isolated areas of patination are most prominent is near base.

Face B: Flake patterns are similar with feather-edge terminations meeting near the midline. Heavy patination (Is this from being under the windshield?) along with same polishes and residues of Face A.

Base: Patination dominates the surface. Flake scars are smaller but continue pattern of larger flakes terminating near the midline.

Edge: Sinuous and fairly uniform with smaller deep offset flake scars making the edge less uniform.

General Notes: Although incomplete, this biface segment is almost exactly the same size as complete bifaces 9 and 19. This biface came from Mr. Hegars' truck. He found it earlier and kept it on the dashboard of his truck.

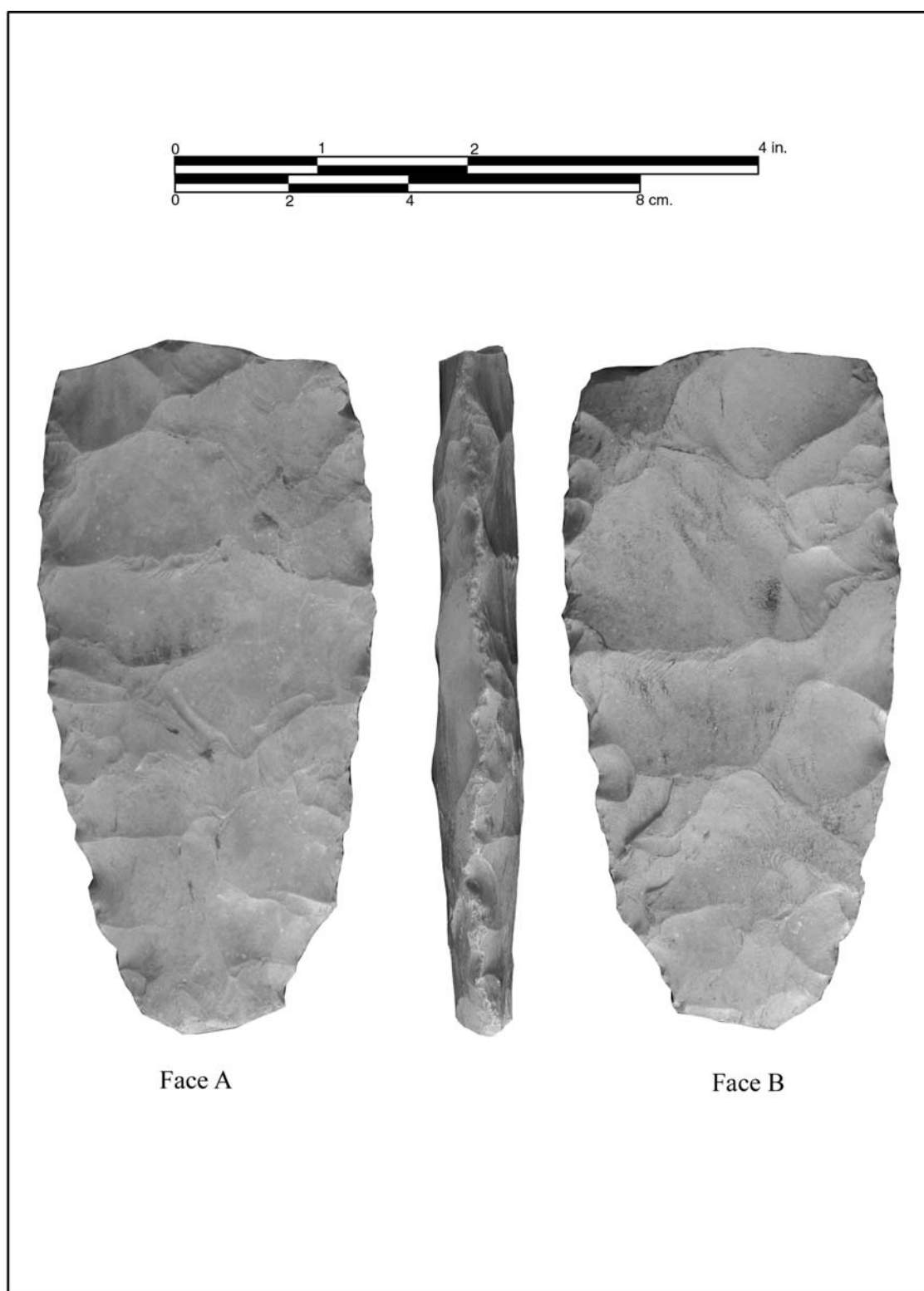


Figure A-26. Biface 26

## APPENDIX B

### DEBITAGE ANALYSIS AND OSL DATA

**Hegar Cache (41HR1030)**  
**Debitage Analysis**

Lot #	Debitage	Tool			Material	Size (mm)	Comments (heat treating, fragment)		Count
		Type	Length	Width	Thickness				
A15	Chip					40	Wedge out of a biface edge		1
A15	Tertiary Flake					10			1
B	Secondary Flake					40	Both have cortex on the platform		2
B		Hammerstone				Quartzite	Fist-size stone with some possible battering on either long end		1
B1 Quad 5	Tertiary Flake					40			1
B1 Quad 5	Tertiary Flake					10			1
B2 Quad 3	Tertiary Flake					15	Neither fragment looks like any of the biface material. Their size and aterior suggest ore local gravel		2
B3	Secondary Flake					40	Broken distal end		1
B3	Tertiary Flake					10			1
B4 Quad 7	Secondary Flake	Utilized Flake				60	Edge has some potential usewear		1
B5 Quad 7	Tertiary Flake					10	One looks like it might be of the same material but another one looks like it is not a flake at all		3
Total									15

Area A is Barn

B is Scraped Area

Profile N165/E198.3 OSL Data

Field #	Laboratory #	ALiquots	Equivalent Dose (Gy) <sup>1</sup>	U (ppm) <sup>2</sup>	Th (ppm) <sup>2</sup>	K <sub>2</sub> O (%) <sup>2</sup>	Dose Rate (mGy/yr) <sup>3</sup>	SAR age (yr) <sup>4</sup>
Tube#2N/6S/E/68.3	UIC1631	30	16.23 ±0.54	1.5±0.1	3.9 ±0.1	0.16±0.01	1.31 ±0.05	12.370 ±860

<sup>1</sup>Equivalent dose determined by the single aliquot regeneration (SAR) method following protocols of Murray and Wintle (2003) and Olley et al. (2004). Age is generated on response under blue light excitation after an infrared wash step, thus isolating the quartz component. The 4-11  $\mu$ m polymineral fraction was analyzed.

<sup>2</sup>U, Th and K<sub>2</sub>O was determined by ICP-MS at Activation Laboratories, Inc. Ontario, Canada. Includes a cosmogenic component of 0.16 mGy/yr from Prescott and Button (1994) and an assumed moisture content of 10 ± 3%. <sup>4</sup>All errors are ± one sigma. Analysis completed at the Luminescence Dating Research Laboratory, Univ. of Illinois -Chicago.

References Cited

Murray, A. S. and Wintle, A. G. 2003. The single aliquot regenerative dose protocol: potential for improvements in reliability. *Radiation Measurements* 37, 377-381.

Olley, J. M., Pietsch, T. and Roberts, R. G. 2004. Optical dating of Holocene sediments from a variety of geomorphic settings using single grains of quartz. *Geomorphology* 60, 337-358.

Prescott, J. R. and Hutton, J. T. 1994. Cosmic ray contributions to dose rates for luminescence and ESR dating: large depths and long-term time variations. *Radiation Measurements* 23, 497-500.



Profile N154/E226 OSL Data

Table 1: Optically-stimulated luminescence (OSL) data and ages on fine-grained quartz extracts from the Hegar Site, Texas determined by the Luminescence Dating Research Laboratory, University of Illinois at Chicago.

Sample number	Laboratory number	Fraction (um)	Aliquots	Equivalent dose (Gray)	I/ (ppm)	Th <sup>z</sup> (ppm)	K <sub>2</sub> O <sup>a</sup> (%)	Cosmic dose (mGray/ yr)	Moisture content (%)	Dose rate (mGray/yr)	OSL age <sup>c</sup> (yr)
1A, 63 cm	UIC1775	4-11	30	7.44 ±0.12	0.9 ±0.1	2.3 ±0.1	0.08 ±0.01	0.194 ±0.019	10±3	0.837 ±0.042	9010 ±740
2A, 90 cm	UIC1773	4-11	30	14.38 ±0.47	0.9 ±0.1	2.4 ±0.1	0.17±0.01	0.186 ±0.019	10±3	0.977 ±0.049	14,730 ± 1180
3 A, 105cm	UIC1774	4-11	29	29.93 ±0.46	1.0±0.1	2.4 ±0.1	0.02±0.01	0.183 ±0.018	10±3	0.843 ± 0.043	33,130 ±2850

Equivalent dose analyses by the single aliquot regeneration technique under blue light excitation (470 ± 10 nm), with an infrared wash (830 ± 10 nm) (Murray and Wintle, 2003; Olley et al., 2004).

<sup>a</sup>U, Th and K<sub>2</sub>O determined by ICP-MS by Activation Laboratories, Inc., Ontario, Canada.

<sup>c</sup>Cosmic ray dose rate estimated from Prescott and Hutton (1994).

Age is from datum year of 2000 AD and age error is ± 2 sigma; 95% confidence interval.

References Cited

Aitken, M. J., and Bowman, S. G. E. 1975: Thermoluminescent dating: Assessment of alpha particle contribution. *Archaeometry* 17, 132-138.

Murray, A. S., and Wintle, A. G. 2003: The single aliquot regenerative dose protocol: potential for improvements in reliability. *Radiation Measurements* 37, 377-381.

Olley, J. M., Pietsch, T., and Roberts, R. G. 2004: Optical dating of Holocene sediments from a variety of geomorphic settings using single grains of quartz. *Geomorphology* 60, 337-358.

Prescott, J. R., and Hutton, J. T. 1994: Cosmic ray contributions to dose rates for luminescence and ESR dating: large depths and long-term time variations. *Radiation Measurements* 23, 497-500.

## VITA

Name: Victor Joseph Galan, Jr.  
 Address: 4215 Red Oak  
 Nacogdoches, Tx 75965  
 Email Address: detac99@hotmail.com  
 Education: B.A., Humanities (Archaeology), Stephen F. Austin State University,  
 1994  
 M.A., Anthropology (Archaeology), University of Arkansas at  
 Fayetteville, 1996  
 Ph.D., Anthropology (Archaeology), Texas A&M University, College  
 Station, Texas, 2007  
 Publications: Galan, Victor J., 1998  
 Excavations at 41TT653: The Ear Spool Site. In *Cultural  
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 Galan, Victor J., 2007  
*A Cultural Resources Survey of the Proposed Escondido Draw  
 Off Road Vehicle Park Crockett County, Texas.* Deep East Texas  
 Archaeological Consultants. Project Number 162. Nacogdoches.  
 Employment: Deep East Texas Archaeological Consultants, Owner, August 1999 to  
 present  
 Post, Buckley, Schuh & Jernigan (PBS&J), Archaeologist, 1996 to  
 1999  
 Spears, Inc., Archaeologist, 1994 to 1996